R.A.F.V.R.

25th March 1940.

To the Medical Examiner.

Dear Sir,

With regard to the Thesis now submitted I would bring to your notice that I have had written permission from the University Authorities to include statistical tables of width wider than the regulation paper, provided that the sheets are folded in to the correct size.

Further I would record that in the bibliography I have not mentioned the British Empire Rheumatism Council, whom I quote in the text. This is in accordance with the request of Sir Frank Fox, who kindly forwarded to me a copy of the Council's unpublished memorandum on Rheumatism.

I have the honour to be, Sir,

your obedient servant,

(David Stevenson.)

M E D I C A L T H E S I S

SUBJECT:

INDUSTRIAL RHEUMATISM

"A critical and statistical survey of the ætiology, incidence and treatment of Industrial Rheumatic and Allied Manifestations, as occurring in the large industrial group comprising the Central London Omnibus Workers"

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For presentation to The University of Edinburgh

INDUSTRIAL RHEUMATISM

A critical and statistical survey of the æetiology, incidence and treatment of Industrial Rheumatic and Allied Manifestations, as occurring in the large industrial group comprising the Central London Omnibus Workers.

SECTION I

INTRODUCTORY OUTLINE

INDUSTRIAL RHEUMATISM

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In this thesis it is proposed to examine the incidence, aetiology and treatment of rheumatic and allied manifestations occurring among a representative group of the Central London Omnibus Workers, and to trace out as far as possible the main factors in causation of these conditions, with special emphasis on those factors which can to a greater or lesser extent be alleviated or eradicated by the adoption of appropriate preventative measures. In order that it may be possible to draw certain conclusions with regard to factors affecting these omnibus workers to any abnormal extent, occasion will be taken, where possible, to compare these figures with similar incidence figures among workers in other spheres of industry. It is proposed, also, under the section on treatment to pay special attention to the benefits arising from physiotherapy and electrotherapy, based upon the author's four years' experience in charge of a rheumatic clinic for the treatment of the Central London Omnibus Workers.

The incidence figures relative to the Central London Omnibus Workers have been collected during the author's work at the above mentioned clinic. This clinic belongs to the London General Omnibus Company's Friendly Society. It has a membership of some 28,000 men, who are all engaged in omnibus work, and this membership comprises 78 percentage of the total omnibus workers employed in the operation of the Central London omnibuses. All these members are eligible to apply to this clinic for the treatment of rheumatic and allied conditions. Treatment at this clinic is almost entirely a combination of physiotherapy and electrotherapy and, as there are many non-rheumatic conditions which can derive benefit from such treatment, a certain number of the cases seen each year do not fall strictly into the category of rheumatic and allied conditions; (Table II, page 9) but, as will be indicated in later figures, the vast majority of the cases are in the rheumatic group. Cases falling into other categories are noted in the yearly figures. Reference to Table I, page 8, will show the main conditions for which we are ready to give treatment. All the members of the London General Omnibus Company's Friendly Society are eligible to apply to the clinic for treatment of the conditions set out in Table I. It cannot be claimed that all these men apply for treatment for any and all attacks of any of these conditions, and it is therefore only possible to construct figures relative to the actual patients who attend the clinic. Inasmuch as all are eligible to apply for treatment however, it seems correct to assume that the figures of those who actually do attend the clinic form a true relative representation of the types of conditions affecting these men. In order that this representation may be as accurate as pos-

sible, particular attention will be paid to the percentage figures which any one condition bears to the whole group rather than to the gross figures of incidence.

In this connection it is of interest to note that in the yearly figures compiled at the London General Omnibus Company's Rheumatic Clinic, several non-rheumatic conditions came to light which had previously been diagnosed as rheumatic, and from the point of view of general interest the more outstanding of these have been noted in Table II. It should be noted also, however, that there were also found rheumatic conditions in certain cases, which had previously been diagnosed as non-rheumatic.

It would perhaps be beneficial at this stage to examine in more detail the actual word "rheumatism", and, if possible, the sense covered by "rheumatic manifestations". In all my reading on this subject I have been unable to find any clear, concise or adequate explanation of what we mean, or should mean, by "rheumatism" and when one finds that the co-authors of the Annals of Internal Medicine, in their excellent annual review of rheumatism and arthritis, (30) have read over 3,000 papers on this subject without finding any satisfactory explanation, it seems not surprising that my less wide reading should have produced no clear elucidation.

The United States Public Health Service in conducting its recent national survey (92) included in the rheumatic group arthritis, gout, neuralgia, neuritis and lumbago. The inclusion of gout is a matter about which there is much controversy and difference of opinion. Crowe represents strongly that gout and those forms of arthritis due to a specific microbe are not rheumatic. Poynton and Schlesinger (75) make the very true observation that most difficulties of nomenclature and classification would be resolved by definite establishment of the actual cause. Meanwhile a broad classification must be adopted on the grounds that, in this matter, commission is a lesser evil than omission and consequently it is better to include a condition now, which may later be proved non-rheumatic, than to find later that we have in the past left out some important aspect of the disease complex.

For the purpose of this thesis it has been decided to adopt as a basis the classification made by Glover, in the Ministry of Health Reports, (35) as being one of the most widely adopted and most reasonable yet produced. In the title of this thesis a defensive increase has been adopted by the use of the term "rheumatic and allied manifestations". Admittedly this is but a further logodædaly and is non-committal but it at least leaves the matter open. I have outlined Glover's classification in full at the end of this section.

The one main fact, concerning which there can be no argument, is that this group of conditions constitutes one of the most important medical, industrial and sociological problems of the present day. Statistics both in this country and abroad confirm

that these conditions occupy the top position in disease prevalance - an unenviable position - and the second position in disability and invalidity production. The fact that rheumatism occupies a relatively low position as a cause of death accounts in part, perhaps, for the slow progress forward in elucidating its aetiology, its symptomatic treatment and above all its preventive treatment.

TABLE I

CONDITIONS SUITABLE FOR TREATMENT

A.

The following conditions are suitable for treatment at this clinic.

RHEUMATIC

- Fibrositis
  - Lumbago
  - Myalgia
  - Myositis
  - Paniculitis
- Arthritis
  - Osteo-arthritis
  - Rheumatoid Arthritis
  - Atrophic Arthritis
  - Mono-Articular Arthritis
  - Arthritis Deformans
- Muscular Rheumatism
- Subacute Rheumatism
- Synovitis
- Gout
- Neuralgia
- Rheumatic Torticollis.

NERVOUS

- Neuritis
  - Brachial
  - Sciatic
  - Facial
  - Peripheral
  - Intercostal
- Nervous Debility

MISCELLANEOUS

- Metatarsalgia
- Pes Planus
- Coccygodynia
- Erythema Pernio
- Allopecia Areata
- Post-Traumatic Ankylosis
- Aesthenia and Atonia.

B.

The following conditions may be suitable for complete or partial treatment at this clinic, and should be examined here with a view to such treatment, if applicable.

- Monoplegia
- Paraplegia
- Hemiplegia
- Progressive Muscular Atrophy
- Pseudohypertrophic Muscular Atrophy
- Chronic Anterior Poliomyelitis
- Disseminated Sclerosis
- Spasmodic Torticollis
- Intermittent Claudication
- Visceroptosis
- Gastroptosis
- Acne Vulgaris
- Impetigo
- Chronic Eczema
- Furunculosis

TABLE II

NON-RHEUMATIC CONDITIONS

Carcinoma
Sarcoma

Syringomyelia
Disseminated Sclerosis
Paralysis Agitans
Progressive Muscular Atrophy
Parkinsonism
Von Recklinhausen's Disease
Migraine

Cerebral Thrombosis
Endocarditis
Myocardial Degeneration
Raynaud's Disease
Arterio Sclerosis
Hyperpiesia
Phlebitis
Varicose Veins

Appendicitis
Pleurisy
Cystitis
Pyelitis
Nephritis
Otitis Media

Deranged Semi-lunar Cartilage
Lax Ligaments Knee Joint
Post-Traumatic Aesthenia

Scabies
Psoriasis
Alopecia Areata
Seborrhoeic Dermatitis
Vitiligo

Tuberculosis
Tuberculid

Thyrotoxicosis

Peptic Ulcer

Osteitis Deformans

Diabetes

Prostatic Hypertrophy.

GLOVER'S CLASSIFICATION (35)

GROUP A

1. Rheumatic fever (acute rheumatism)	Usual text-book description.
2. Subacute rheumatism (including rheumatic purpura)	= a mild attack of rheumatism; pyrexia not exceeding 101°, responding to salicylate treatment; often accompanied by endocarditis; without chronic joint deformities.

GROUP B. - Non-articular Manifestations

3. Muscular rheumatism (myalgia) including fibrositis, pleurodynia and torticollis, but excluding lumbago.	Symptoms of characteristic pain, aching and stiffness sometimes accompanied by physical signs of thickening of the fibrous tissue and by the presence of nodes.
4. Lumbago	Myalgia of the erector spinae muscles (separated for classification from No.3 as being an easily distinguishable clinical entity and on account of its occupational interest)
5. Sciatica and brachial neuritis.	

GROUP C. - Chronic Joint Changes

6. Rheumatoid arthritis (infective peri-arthritis)	Usually with an acute initial attack of pyrexia of considerable length; many smaller joints usually affected, especially first and second phalangeal joints, spindle-shaped joints, the temporamaxillary joint is often affected; changes mostly peri-articular often accompanied by much fibrositis; lesions often bilaterally symmetrical, nutrition of patient almost invariably bad; patients usually females.

7. Osteo-arthritis, including malum coxae senilis.	Usually afebrile; gradual onset, often at first confined to one large joint, fewer and larger joints affected, especially knees and hips; grating, lipping, eburnation, osteophytes; lesions often asymmetrical, patient usually well nourished.
8. Gout - (a) acute (b) chronic	Usual text-book description. Polyarthritis with a definite history of repeated attacks of acute gout or the presence of tophi.
9. Chronic joint changes unclassifiable	Chronic joint changes which cannot be allocated to any of the above.

SECTION II

THE INDUSTRIAL ENVIRONMENT

SECTION II.

THE INDUSTRIAL ENVIRONMENT

At this stage it would be advisable to examine the average day of a Central London Omnibus Worker with special application to the subject now under investigation, and bearing in mind that much depends upon the stresses and strains under which these men work. It will be agreed, at the outset, that it is quite impossible to give a completely clear cut and definite picture of such a day, as in a minor way the work and the consequent stresses and strains will vary from route to route, whether we are dealing with a single or double decked omnibus, whether it is winter or summer, or whatever road conditions prevail at the time; but it is possible to outline the average life and the average factors affecting the main issues. We shall consider this matter under several main headings:

Hours of work
Rest periods
Meal facilities
Type of omnibus
Weather
Road conditions
Public service.

Most of the information regarding these conditions is taken from the Ministry of Labour Report on the Health of the Central London Omnibus Workers (63).

The hours worked by these omnibus workers have been changed from time to time and whereas in 1929 the maximum total time on duty on any one day was nine hours, this has now, by agreement, been reduced to a period of eight hours. It should be noted, however, in this respect that some 10 percent of the omnibus workers, on any one day, have a spreadover duty of nine-and-a-half hours to twelve hours. By this is meant that while the total time on duty does not extend beyond the eight hour limit, the duty time is spread into two shifts with an interval in between. This interval, it should be noted, is usually not sufficient to allow the affected man to return home and amounts to time which must be "killed" before resuming his duty. On the average, three shifts are worked by these men. The first is termed the early shift, and is one which finishes not later than 6 p.m. on weekdays and 7 p.m. on Sundays. The second is termed the middle shift and is one which finishes not later than 9 p.m. The third is termed the late shift and involves working until the early hours of the following morning. It follows, of course, that these varied shifts commence at such hours to ensure that not more than eight hours of actual time on duty are involved. It has been agreed in discussion between the Transport Board and the omnibus workers' representatives that the spreadover duties should be as follows:

(1) The maximum spreadover of any duty (i.e. the period of time between booking on at the start and booking off at the finish of the day's duty) must not exceed twelve hours on weekdays and ten hours on Sundays.

(2) Not less than 80 percent of the duties must be scheduled to be completed within a spreadover of eight-and-a-half hours, so that not more than 20 percent of the duties may exceed a spreadover of eight-and-a-half hours on any day.

(3) Not more than 10 percent of the duties may exceed a spreadover of nine-and-a-half hours on weekdays.

The present custom is for each man to change from shift to shift at weekly intervals and it is provided that there shall be a complete rest day in each working week. The question of this recurring change at such short intervals, involving as it does change of meal times etc., will be further discussed in the succeeding paragraph.

According to the agreement laid down between the employers and the men, a minimum meal relief must be scheduled in every duty which has a spreadover of more than six hours, with the provision that where the spreadover is less than eight-and-a-half hours and the meal relief exceeds forty-five minutes, the time in excess of forty-five minutes is counted as time worked. It will be noted that there are a small proportion of duties, not exceeding six hours in duration, where the full day's work is completed without relief. This means that the man has no time for meals during this period, apart from the few minutes of time allowed at the terminal point. This latter time is termed "stand time" and will be referred to later. It will be appreciated from the previous statements with regard to duties that great irregularity exists in the time at which meals are taken, consequent upon the irregularity of working hours and not only is there this irregularity, but the meal relief period is variable even among the duties scheduled on the same kind of shift. For example an omnibus worker of an early split shift, that has a spreadover duty, might be scheduled any one week to take his meal relief after a spell of two hours work; but this meal relief might not come until the end of a spell of some five to five-and-a-half hours' work. The "stand time" previously referred to amounts on the average to some thirty minutes in the total working time. When this is reckoned as divided into periods roughly coming at the end of an hour's omnibus running time, it will be appreciated that only a few minutes are obtainable at each terminal turning of the omnibus. Opportunity may at these times be taken to obtain some light refreshments, but it has to be kept in mind that this time may also have to be used for washing and other toilet necessities. In recent years facilities have to a great extent been provided for the quick snacks which may then be possible. It is, however, a not uncommon condition to find that opportunity thus presented is utilised in the drinking of tea, which has probably been standing some considerable time, and which

at the best has to be hurriedly ingested to the accompaniment of any other food then taken. This question of irregularity of meals was gone into in particular detail by Bradford Hill (4) and it was found that in 1933 to 1935 the omnibus drivers had a relative excess of sickness attributed to gastric causes of 12 to 14 percent over the figure shown by the tramway drivers, while the omnibus conductors had a similar excess of 15 to 18 percent over the figures to the tramway conductors. In this respect it is of further interest to note that the omnibus drivers were found to have a rather lower rate of sickness from all causes and from gastric causes, than the omnibus conductors. These figures serve to show that the irregularity of meals, taken in consideration with other factors, to be brought out later in this thesis, has definitely given rise to an excess of sickness. Another point noteworthy in this connection is that the weekly change of shift, such as at present in operation, results in the main meals, taken before and after the daily work, varying in their time from week to week. The continued reflex production of salivary and gastric juices in anticipation of a regular meal is entirely upset and either the gastric acidity is allowed to react upon the mucus membrane or a meal is thrust upon the stomach in the absence of due preparatory production of digestive juices.

With regard to the types of omnibus on the Central London services there are several points of importance with regard to the subject under consideration. Firstly the majority of the omnibuses are of the double decked type, but a small proportion of the routes are serviced by single decked omnibuses. The point here is mainly one of the presence or absence of stair climbing as affecting the conductor and the presence of draughts also affecting the conductor. The driving cabin is usually entirely closed up with the exception of the right hand side which is entirely open, and exposes the driver to the full play of the outside elements on his right side. When it is noted that the driver in many of these omnibuses, especially the earlier models, is sitting in very close proximity to the engine it will be appreciated that there is a direct interflow of air currents present, hot air arising from the engine and cold - or at best cooler - air from the outside.

It has been established by many authorities that the danger in the inter-flow of air currents arises usually at the point where air of two temperatures meets and that it is vastly more preferable to be either completely cold or completely warm rather than that one part of the body be at a different temperature from another. Another point arising here is the entrance into the driving cab of the actual combustion fumes from the engine. As regards the driving seat this, in its average position is so situated that the driver is sitting practically straight up, with the foot pedals so placed as to require practically right angled flexion on the knee joints. There is seldom any provision made for the natural lumbar curve and, while many of these seats are adjustable to a limited extent, a situation not infrequently arises where a short legged driver has to sit practically on the edge of the seat

in order to manipulate the pedals. The actual seat itself is relatively hard and there is not usually much allowance for spring give in relation to muscular pressure - this point being of special importance with regard to pressure on the sciatic nerve. A further point in correlation to the engine heat, the natural heat of muscular exertion and the form of the driving seat, is the accumulation of sweat in the lumbar and ischial areas, an accumulation which literally may assume the proportions of a pool of sweat.

As regards the conductor we have to consider that the platform in the rear of the omnibus is entirely open on the on-side and in the double decked type of omnibus the stairway is placed directly opposite this open side. We have here the makings of a not inconsiderable draught and this is more especially prominent when the window is open at the rear of the top deck. In order to be out of this draught it is necessary for the conductor to take up his position, at such times as he is not otherwise engaged in the collection of fares and other duties, as far back on this platform as possible. In most of the omnibuses there is not much room for this retreat from draught, nor correspondingly is there much room for the conductor to retreat into safety from the two streams of passengers from the upper and lower decks. If one pays particular attention to the conductor at such times it will be noted that his knees are subjected to a varying amount of trauma from parcels and cases carried by these passengers. In the case of double decked omnibuses there is also the factor of considerable ascending and descending of stairs, this being carried out usually at a time when the omnibus is not stationary and that, therefore, there is a tendency to be thrown about on the stairs. As regards the omnibus as a whole there is a large element of vibration to be considered. This vibration may be divided into two categories:

(a) vibration due to the engine,
(b) vibration due to the irregularities of the road surface.

As regards the engine the majority of these omnibuses are fitted with an engine whose vibration is transmitted throughout the entire omnibus. This is a point which has been personally tested by the author and it has been demonstrated clearly that engine vibration is transmitted through the superstructure of the omnibus. Experiments have from time to time been carried out with independent suspension of the engine such that its vibration is to a lesser or greater extent not transmitted to the rest of the omnibus, and the most satisfactory form of such has been where the engine is entirely suspended in rubber. It has been, however, unfortunately found that such rubber suspension is more costly, and that there is also a tendency for the rubber to deteriorate in the presence of oil and other chemicals. Such a form of suspension has consequently been considered unsatisfactory for general omnibus work. This is a matter of extreme regret, and, while it is not possible to demonstrate clearly and concisely the general effects of vibration, it seems that the benefits to be gained by independent rubber

suspension of the engine would exceed by far the additional outlay involved. A further form of engine suspension is what is known as tangential suspension and, while this form is not so satisfactory, it certainly is a great improvement over the system in use at present. The introduction in more recent omnibus models of fluid transmission has served to cut out many of the vibratory effects of gear changing and has certainly lessened the strain put on the left leg, although complaint is often heard about the stiff clutch on the new fluid transmission oil fuel type of omnibus. As regards vibration from the road surface this will be dealt with more explicitly under the heading of road conditions, when opportunity will be taken to set out the outstanding effects of vibration.

On the subject of weather conditions we can take as understood without further specific comment the actual weather conditions prevailing in London during the various seasons of the year. Here we are concerned only with the actual influences that such conditions have on the Central London Omnibus Workers. It would seem natural to anticipate that, all other things being equal, the winter months with their added quota of damp, cold and generally other trying conditions would be a time for much increased incidence of the various rheumatic conditions. Such at any rate is the general finding for the average human being. A reference to the figures in Table III (pages 31 and 32) and Table IV (pages 34 to 38) will, however, show that this is not to any extent the case in the group of men under investigation. It will be seen that, taken on the average, there is no distinct and recurring difference throughout the various weather conditions. The only period where any striking variation is present is for the months of April and May, 1937, but it will be submitted later that there is a special reason for the figures of these two months, and they will be dealt with at length under the heading of mental and nervous manifestations. This absence of any distinct seasonal incidence is a point of extreme importance, and strongly supports the view that there are at work here, factors of such wide and constant effects as to negate the usual seasonal influences. At one time during the collection of data for this investigation an attempt was made to note the time of year when each individual condition had been first noted, this being done in an endeavour to show, where possible, any seasonal difference. It was found however that there was usually so much lack of precision in the mind of the patient as to when the condition really commenced - a lack of precision due to such factors as previous illnesses, remission periods, actual threshold above which what had been just an "ache" became an actual medical entity and tendency to class any and all pains vague or exact as rheumatic - that such investigation was found unlikely to be of real value. In other words, while such an investigation could be carried out, and was for several months, the results are of no practicable value. It must therefore be left to the figures in Tables III and IV to substantiate the point made that there is little or no definite recurring seasonal incidence.

The next point is that of road conditions. This is a

very large subject with varying and ever changing aspects, and we must consider it only as regards some of its aspects more especially applicable to the matter under consideration. There is the question of actual volume of traffic on the roads. There must naturally be times when traffic is heavy and times when it is light and this must ever be a relative matter. But one fact stands out clearly and that is the marked difference in traffic volume between the Central London and the Suburban areas. In considering the Central London area, with its relatively consistent high traffic volume, there is also noted by common consent the so called "peak periods" at which times the traffic volume reaches such proportions that anything from five to twenty minutes or more may be spent waiting in traffic blocks. It will be recognised that while the average time schedule allows a certain amount of latitude for such lost time, there must be many occasions when a situation arises whereby some means must be adopted to make up any excess time lost in this way. The omnibus worker knows that if he arrives ten minutes late at the end of a journey the chances are that there will result some curtailment of his "stand time". Admittedly he has officially the right to insist upon his allotted period of "stand time", but in practice it is usually found that it is easier for the driver to forfeit a certain amount of "stand time", more especially if the conclusion of his next journey means the conclusion of his work for the day. There is only one way to make up any time lost in heavy traffic and that is to drive the omnibus through the Suburban areas at greater speed. This does not mean at speed beyond that allowed by regulations, but means that as little time as possible is spent at passenger stops and on the road. It will be seen that here we have a very potent cause for friction between passengers, driver and conductor and even between other users of the road. At the Court of Inquiry (64 65) held into omnibus work it was noted that the increase in the average speed of the omnibus which took place in 1932-3 was an increase outside this central and highly congested area, in other words an increased speed was demanded in these so called Suburban areas. Now it has been shown by the Metropolitan Police Censuses of Traffic, and by the Bressey Report (5) that there has been a progressive congestion of traffic on the roads, and it would seem that its rate of increase during the past few years has been greater outside than inside the Central area.

In their report the Ministry of Labour said: "there is no doubt that this greater density of traffic has led to an increase in the frequency of the operation of brakes and clutches and has otherwise contributed to the difficulties of manœuvring the vehicles". It will be seen that the men have had, therefore, not only to work to a faster time schedule but the possibilities of making up time lost due to increased volume of traffic have been to a great extent cut down by the increase of Suburban traffic. With respect to the conductor the increased traffic volume probably means a relative increase of passengers with the consequent added work entailed. Not all of the many routes covered by these omnibuses are in any way equal in respect to traffic volume, as indeed

in most other ways, and it must not be assumed that because for example route No.15 is one where there is always heavy traffic to be encountered, that therefore all routes are the same, but as the majority of routes pass at some point or another through the same part of the Central area there is usually some time when they are subjected to increased traffic effects.

During the year 1939 occasion was taken to note in the case of each driver or conductor examined at the clinic the actual route upon which the man was engaged. It was hoped in this way that it might be possible to show some actual indication of what routes were more prone to result in sickness; but when it is borne in mind that there are 260 different routes operated by the Transport Board, and that not only do the conditions in many respects vary from time to time on each individual route but also from one route to another, and that further the men are not always employed on the same route for any distinct period, it will be admitted that nothing of any real statistical value could accrue from such observation, unless the investigation was pursued for some twenty years. From actual questioning of these men it has been indicated from time to time that there are some routes which they themselves look upon as more strenuous than others, and the general rule is to find that any such singled out route is one containing more than the average amount of City running, which means that a higher proportion of the work is carried out in the more congested areas. There is an interesting point on the other side which was put to me by an omnibus worker who had been transferred from City work to what might be termed country work. This man's individual reaction was such that the so called "monotony" of running long distances in the country, with infrequent stops, was more trying than the relatively greater stress of the busy City route. Presumably this change from the City route, giving more time for relaxation between attending to the needs of passengers, was a reactionary feeling too far in the other direction in this individual. It should be borne in mind, however, that this was a solitary opinion against the former view which had been expressed over and over again.

The actual road surface presents the next factors. Here we may quickly pass over such things as dampness adding to the trials of driving, mainly from the possibilities of skidding, and come again to the question of vibration. In their report dealing with these matters the Ministry of Labour noted that "vibration was also mentioned as a possible factor, but more on theoretical grounds than on positive evidence". While I am comforted in the knowledge that vibration was at least mentioned, I am convinced that it is not only a possible factor but is a distinctly definite one. I must agree, however, that positive evidence is difficult to find - this I will refer to later - but I do hope to be able to give strong circumstantial evidence of its effects. It has, so far, been found impossible to lay a road surface of such resistive powers that for any length of time it will retain any great degree of smoothness, and when to this is added the unevenness caused by

such things as tramcar rails, hydrants and the at first raised and later usually hollowed tracks resulting from the many and frequently occurring municipal excavations, there remains a surface such that any vehicle no matter how well cushioned against unevenness must in its travel suffer a good many shocks and bumps. Now this may seem at first sight a gross over-statement, and may even appear ridiculous, but if you will admit, as you must, that even a private car tends to bump over these many irregularities of surface, a car whose shock absorption is potentially greater than that of the omnibus, how much greater will these irregularities be transmitted throughout the omnibus; and while a car will actually register a jerk or bump from these obstacles the omnibus with its superior weight will register a greater shock over the gross irregularities and a relatively finer vibration over the lesser of these obstacles, but nevertheless each vibration acting compoundly will accumulate into a most noticeable and persistent vibration affecting the entire omnibus and all who are in it.

A further point in this respect is that the greater the pressure of air in the tyres, over the optimum of comfort, so will the vibration be the greater, and it is unfortunately found that the greater the pressure in the tyre the longer does it last. The conclusion to be drawn from this does not need further comment. From personal experience, and I think that this will be borne out by any and all people who have done any travelling, even a few hours' journey in a private car, with its lesser vibratory effects, suffices to make one undoubtedly conscious of travel. During the time of travel and for some considerable time afterwards there is felt in the body either the actual vibration or the resultant effect of vibration. The proof of this is in the universal experience of all people. Now it has been made clear above that this vibration is greatly enhanced when travelling in omnibuses, and from the point of view of the employees, when we consider that they are subjected to such vibration for periods anything up to six hours daily over a period of years, it must surely be admitted that vibration ceases to be a possibility but becomes a definite entity and that its effects must be manifested not only during the actual phase of vibration but for long afterwards. One might further enlarge this point by reference to a very old humorous story in which it was stated that the omnibus conductor when engaged at home in writing a letter required artificial vibration of the table before he could write with any feeling of normality. You may say here that because he has become adjusted to it he has therefore become immuned to this vibration, but that cannot be so. While it may, possibly rightly be held by some people that our life here consists of a series of vibrations and their effects, these vibrations are said to be of etheric origin and it was not meant that these vibrations should be aggravated by a state of artificially constructed and much more gross vibrations, otherwise we would surely have found the entire universe to be in a constant agitation in keeping with such gross vibrations.

During the course of this investigation it was thought

that it might be possible, by fixing a suitable instrument to an omnibus, to register and analyse any and all vibration either from the road or engine. It was soon realised that short of a three dimensional form of record such investigation would have no value, and that even when such a record was obtained one would have only procured a record of the vibration which had existed at a particular time under the particular conditions of the road and the omnibus. In other words all one would in reality gain would be proof positive of the presence of vibration as such, and surely that is no longer a matter of doubt. Short of the utilisation of an actual experimental omnibus with its full quota of passengers, its varying road conditions and repeated experiments involving speed, road surface, load, wind and many other factors, nothing of value could eventuate from such an investigation. An investigation of such magnitude as that outlined above, and involving so many varied conditions, is out with the scope of this present one, and we must content ourselves here with the essential facts such as the presence of vibration and how on broad lines it may be increased or decreased and by drawing conclusions as to the effects which it may have upon the health of the man employed. With regard to the whole subject of vibration as it may affect the body generally it is of value to note that cases are on record where the shocks absorbed from the road have been sufficient to cause even a fracture of bones, by the sudden throwing of the body upwards with its consequent violent return to the seat or floor as the case may be. This serves, apart from many other things, to increase the traumata to which the conductor is subject by causing him to knock his knees and legs against the omnibus seats in order to retain his balance while his hands are occupied in the carrying out of his duties.

There is a relative scarcity of information as to the effect of vibration on the health of workers. It has been known for a long time, however, that certain trades, where vibratory machines were in constant use, carry with them abnormal risks of the effects of vibration. Serying (84) in discussing the effects which arise from the use of compressed air hand tools noted three particular groups of conditions:

1. The vascular motor changes, which were said to give rise to Raynaud's Disease, going on in some cases to actual gangrene of the fingers. This type of condition has received such pseudonyms as "Dead Hand" and "White Hand".

2. Muscular atrophy, particularly noted in the thumb and thenar muscles. In this category there has been noted as an example the disability known as Dupuytren's contraction.

3. Pain and limitation of movement in the elbow joint, with possible loose body formation.

In these trades there was generally noted a numbness in the hand and arm, which appeared to be gradually progressive, cumu-

lative and, in the prolonged cases, of lasting effect. From time to time there was noted a temporary loss of use in the affected part, and the symptoms were usually increased in cold weather. So far as investigations have gone it appears that an important factor lies in the frequency and amplitude of the vibration.

Burkle-de la Camp (10) reporting on lesions of the muscles, bones and joints due to the use of pneumatic tools - which was a scheduled industrial disease in Germany at that time - drew particular attention to special affections of the humerus, the acromio-clavicular joint, the elbow, the scaphoid and the lunate. He noted a special injury affecting the scaphoid and lunate which was termed a pseudoarthrosis, but he found himself placed in the usual difficulty in deciding whether this was a condition arising directly from and on account of the use of vibratory tools, or whether it was a vibratory aggravation of a pre-existing condition. In dealing with pneumatic tools he noted three different groups:-

1. Pneumatic tools worked on the horizontal, with striking parts, such as in Hammering, Riveting and Moulding.

2. Pneumatic tools with pushing working parts such as in Boring, Road Drilling, etc.

3. Pneumatic tools worked above the horizontal such as in Spraying, etc.

The lesions typically found were in the joints bearing particular strain in each type, for example, the shoulder in Group 2 and the elbow in Group 1.

Poynton and Schlesinger (76) also express views on this matter and state that:-

> "The pathogenesis of an osteo-arthritis of the elbow or shoulder joint in a road-mender who is constantly using a powerful vibrating drill can well be imagined ..... trauma is the basis of many occupational diseases involving the joints, bursae or larger nerves".

Finally in this résumé of the various aspects of service we come to what I have termed "public service", and this is a term used to cover a large variety of possibilities. Firstly we have the important fact that these men in the course of their work are not dealing with an inanimate object such as a machine and are not working by themselves. They are dealing with the general public, and consequently have to cope with, and accommodate themselves to, all the vagaries customary in the human race. In other words they have constantly to pacify the irritable, whether irritable with or without just cause, and only too often have they to make every endeavour to satisfy the, at times, absurdly exacting passengers. While doing this they cannot allow themselves to remonstrate or even point

out a fault on the side of the passenger, as they thereby run the risk of being reported with the consequent upsets which necessarily follow such complaint. They must be able to hear the small voice in the midst of the large noise of traffic, a thing which requires close concentration. They must be ever conscious that they bear the responsibility for the lives of some thirty or more people, and they must therefore restrain the over-anxious passenger from leaving the omnibus before it stops, or from attempting to board the omnibus while in motion. They must hold at bay the ~~overwhelming~~ rush of oncoming passengers until the offgoing passengers have alighted. They must persuade the tired worker that when an omnibus is full they cannot allow him to add his number to those already on the omnibus, bearing in mind that by allowing such a condition they run the risk of penalty. These are but a few of the duties imposed upon these men, and this leads one to the inspection of a very important aspect, and one which may most aptly be dealt with under the present heading. I refer to the mental aspect of this work. Now it must be admitted at once that any and all work involves a lesser or greater form of mental strain. By this is meant that attached to any work there are such mental factors as worry with regard to the progress of the work - whether it will be acceptable to the authorities - will it be turned down - will the man be able to give sufficient satisfaction to retain his position on the staff - will he be able to make sufficient money to keep his family in anything like the conditions he would desire - what will happen to him in the event of illness - will he be able to carry on his work until sufficient money has been saved to look after his later years, when he has ceased to have any earning capacity? Such are some of the general worries which beset any and every working man, and there can be no argument but that such conditions must of necessity exist under the present system, but it is necessary to indicate here the more specialised forms of mental stress and strain imposed by this specialised form of occupation. From what I have indicated above in respect of the frequent irritation and unreasonableness of the general public, it must follow that this in itself will constitute a distinct cause for a certain amount of increased nerve strain.

In the case of the driver we have the continued strain of concentration at the wheel, and a constant anticipation of what the other driver is going to do. In this particular respect it is as well to remember that traffic does not always do what could be reasonably expected and anticipated; it is not the first time that vehicles have precipitately crossed the forward path of a following car, without giving any warning whatsoever, and it also is not the first time that a pedestrian has stepped without warning from the pavement on to the road. In many of these ways an accident may be caused which might not only react unfavourably upon the actual vehicles involved, but will certainly imperil the lives of the passengers in the omnibus if not indeed lead to their actual harm. Coupled with this necessity of concentration and precaution there is the necessity of arriving at the terminus on time, despite the exigencies and vagaries of traffic conditions. Let it be clearly

understood at this stage that I am not here dealing with the actual psychoneuroses whereby such things as fibrositis can, and do in certain cases, have a purely mental rather than physical origin. I am here simply outlining some of the gross ways whereby this type of work throws an abnormally heavy burden upon the psychological balance and mechanism of the worker.

Such then is briefly the average working life of the man in this industry and, for the purpose of drawing conclusions and making recommendations later in this work, it may be of benefit to summarise here briefly the main outstanding points already made, to show in what ways this work entails more than the average stresses and strains of what we might term normal occupational existence.

1. Affecting mainly the omnibus driver.

   (a) Fumes from the engine.
   (b) Draught entering the driving cab from the open off-side.
   (c) Draught entering the driving cab from the sides of the foot pedals.
   (d) Postural strain due to lack of provision for lumbar curve, and due to insufficient spring to relieve pressure on the sciatic nerves.
   (e) Gross lumbar sweating due to the heat of the engine.
   (f) Constant mental effort required for negotiating traffic and other road conditions while endeavouring to run to schedule.

2. Affecting mainly the omnibus conductor.

   (a) Draughts encountered while occupying platform at rear of omnibus.
   (b) Trauma to legs and arms from passengers' luggage and due to efforts to maintain a stable equilibrium in the presence of omnibus vibration.
   (c) Mental effort required to meet the demands of the general public, to pacify and to ensure that the passengers do not contravene traffic regulations.

3. Affecting both drivers and conductors equally.

   (a) Constant weekly change of duty times, involving irregularity of meal times, spreadover duties involving long periods while the intervals between are not of sufficient length to allow of real relaxation.
   (b) Vibration from the engine and from the road.
   (c) Relatively very short time allowed on turning the omnibus at the terminus with consequent shortage of time for refreshment, relaxation and general toilet.

(d) Insufficient opportunity for rest of mind and body prior to partaking of a meal.

It would seem fit to end this somewhat detailed reconstruction of duties and strains by a quotation from the recent Ministry of Labour report where it is stated that:-

> "while, therefore, it is impossible to compare accurately the 'intensity' of work between one time and another or between one occupation and another, it is nevertheless self evident that the work of the omnibus crews is to-day of an exacting nature - as is indeed shown by the high standard of fitness rightly required of them by the Board. It is the opinion of some of us that the 'intensity' of the day's work might well be lightened by an extension of the spreadover which would allow of longer intervals of rest between journeys and spells of duty without any alteration in the present hours of omnibus work. Others take the view that these longer intervals should be provided within the present spreadover limits which would result in a reduction of effective working hours".

and by the inclusion of Appendix 5 (page 26) from the same Report, where the actual rota of duties over a year's cycle on a particular service are set out. This will serve to give a good indication of the range covered by an actual omnibus worker's day.

ROUTE 13. SPECIMEN DUTY ROTA. HENDON GARAGE.

LONDON TRANSPORT—CENTRAL BUSES.
IN OPERATION FROM 15TH FEBRUARY, 1939.

APPENDIX 5.
(See paragraph 19 (*f*).)

Shift.	Sunday.					Monday.					Tuesday.					Wednesday.					Thursday.					Friday.					Saturday.				
	Start Duty.	Relief. From	Relief. To	Finish Duty.	Total Time on Duty.	Start Duty.	Relief. From	Relief. To	Finish Duty.	Total Time on Duty.	Start Duty.	Relief. From	Relief. To	Finish Duty.	Total Time on Duty.	Start Duty.	Relief. From	Relief. To	Finish Duty.	Total Time on Duty.	Start Duty.	Relief. From	Relief. To	Finish Duty.	Total Time on Duty.	Start Duty.	Relief. From	Relief. To	Finish Duty.	Total Time on Duty.	Start Duty.	Relief. From	Relief. To	Finish Duty.	Total Time on Duty.
					h. m.					h. m.					h. m.					h. m.					h. m.					h. m.				h. m.
Early		Rest Day.				6·31 a.m.	11·2	11·54	2·35	7·22																				6·31 a.m.	11·1	11·49	2·29	7·13
Late		*Rest Day.*				*11·34 a.m.*	*4·48*	*5·18*	*7·50*	*7·46*																				*5·6 p.m.*	*9·34*	*10·22*	*12·20*	*6·29*
Early		Rest day.				7·12 a.m.	11·54	12·24	3·5	7·23																				7·6 a.m.	11·49	12·21	2·56	7·18
Late	*4·51 p.m.*	*8·30*	*9·0*	*12·35*	*7·14*			*Rest Day.*			*2·17 p.m.*	*7·22*	*7·58*	*10·20*	*7·27*																*1·34 p.m.*	*4·57*	*5·43*	*8·16*	*5·57*
Early	7·21 a.m.	10·54	11·33	3·36	7·36	7·33 a.m.	12·18	12·48	3·29	7·26			Rest Day.				Rest Day.													7·25 a.m.	12·5	12·37	3·9	7·12
Late	*3·44 p.m.*	*5·54*	*7·21*	*12·11*	*7·42*	*3·23 p.m.*	*6·17*	*6·51*	*11·26*	*7·29*									*Rest Day.*											*4·1 p.m.*	*6·22*	*7·34*	*11·59*	*7·13*
Early	11·7 a.m.	2·46	3·18	4·34	4·55	7·49 a.m.	12·36	1·18	3·59	7·28																				7·49 a.m.	10·1	10·32	3·3	6·43
Late	*6·31 p.m.*	—	—	*12·1*	*5·30*	*3·29 p.m.*	*8·28*	*8·58*	*11·17*	*7·18*																						*Rest Day.*		
Early	10·49 a.m.	1·28	2·48	6·27	6·53	8·23 a.m.	1·12	2·11	5·1	7·49																				8·18 a.m.	10·32	11·23	4·21	7·18
Late		*Rest Day.*				*4·17 p.m.*	*9·10*	*9·40*	*11·59*	*7·12*																				*5·18 p.m.*	*9·46*	*10·28*	*12·26*	*6·26*
Early		Rest Day.				8·41 a.m.	1·36	2·17	5·7	7·55																				8·29 a.m.	10·52	11·57	4·44	7·30
Late		*Rest Day.*				*4·41 p.m.*	*9·34*	*10·10*	*12·14*	*6·57*																				*3·19 p.m.*	*5·40*	*6·16*	*10·44*	*6·49*
Early	9·24 a.m.	2·18	2·56	5·37	7·35			Rest Day.			9·29 a.m.	12·0	12·30	5·43	7·44																6·20 a.m.	9·58	10·28	1·0	6·10
Late	*4·56 p.m.*	*7·32*	*8·9*	*12·40*	*7·7*	*5·29 p.m.*	*10·10*	*11·10*	*1·5*	*6·51*				*Rest Day.*																*4·12 p.m.*	*8·40*	*9·46*	*12·5*	*7·8*
Early	11·4 a.m.	2·48	4·18	5·34	5·45	9·29 a.m.	12·0	12·30	5·43	7·44	7·33 a.m.	12·18	12·48	3·29	7·26	7·33 a.m.	12·18	12·48	3·29	7·26			Rest Day.			7·49 a.m.	12·36	1·18	3·59	7·28	8·7 a.m.	12·53	1·49	4·9	7·17
Late	*1·22 p.m.*	*5·6*	*5·54*	*9·38*	*7·31*	*2·17 p.m.*	*7·22*	*7·58*	*10·20*	*7·27*	*5·29 p.m.*	*10·10*	*11·10*	*1·5*	*6·51*	*5·29 p.m.*	*10·10*	*11·10*	*1·5*	*6·51*	*3·23 p.m.*	*6·17*	*6·51*	*11·26*	*7·29*			Rest Day.			*4·47 p.m.*	*7·21*	*9·0*	*12·42*	*7·10*
Middle	11·19 a.m.	2·56	3·58	7·37	7·33	10·15 a.m.	1·0	1·36	6·45	7·54																						Rest Day.		
Late	*4·28 p.m.*	*7·9*	*7·39*	*12·16*	*7·18*	*3·5 p.m.*	*7·58*	*8·34*	*10·56*	*7·15*																				*5·24 p.m.*	*9·52*	*10·46*	*12·40*	*6·31*
Early		Rest Day.				6·52 a.m.	11·6	11·36	2·17	6·55																				6·52 a.m.	9·6	9·51	2·37	7·0
Late		*Rest Day.*				*11·47 a.m.*	*2·35*	*3·5*	*8·2*	*7·45*																				*6·6 p.m.*	*8·28*	*9·10*	*1·13*	*6·25*
Early		Rest Day.				8·48 a.m.	1·35	2·29	5·19	7·37																				8·41 a.m.	1·16	2·19	4·50	7·24
Late	*6·21 p.m.*	*7·37*	*8·10*	*12·47*	*5·53*			Rest Day.			*3·29 p.m.*	*6·23*	*7·3*	*11·35*	*7·26*																*3·7 p.m.*	*7·34*	*8·4*	*10·26*	*6·49*
Early	10·36 a.m.	2·15	2·46	5·27	6·20	7·38 a.m.	12·24	1·0	3·41	7·27			Rest Day.																	7·39 a.m.	12·21	12·53	3·22	7·11
Late	*3·59 p.m.*	*8·9*	*8·43*	*12·25*	*7·52*	*3·35 p.m.*	*6·23*	*7·22*	*11·47*	*7·27*																				*3·15 p.m.*	*8·37*	*9·10*	*11·42*	*7·54*
Early	8·50 a.m.	1·35	2·15	4·56	7·26	7·54 a.m.	12·42	1·29	4·19	7·48													Rest Day.							7·53 a.m.	12·37	1·9	3·39	7·14
Late	*2·10 p.m.*	*5·49*	*7·37*	*11·51*	*7·53*	*4·23 p.m.*	*7·11*	*8·28*	*12·30*	*7·22*																				6·24 p.m.	8·46	9·22	1·25	6·25
Early		Rest Day.				8·17 a.m.	1·6	1·53	4·43	7·49																				8·14 a.m.	1·1	2·5	4·27	7·28
Late		*Rest Day.*				*8·11 a.m.*	*10·33*	*1·12*	*6·21*	*7·41*																				6·36 p.m.	8·58	9·34	1·43	6·31
Early		Rest Day.				7·20 a.m.	12·6	12·36	3·17	7·27																				7·12 a.m.	11·33	12·5	2·43	6·59
Late		*Rest Day.*				*4·47 p.m.*	*9·40*	*10·40*	*12·37*	*7·5*																				*4·30 p.m.*	*6·52*	*8·46*	*12·47*	*7·32*
Early	9·48 a.m.	2·24	3·9	5·19	6·46			Rest Day.			9·2 a.m.	1·53	2·41	5·31	7·44																8·46 a.m.	1·24	2·32	5·2	7·31
Late	*4·8 p.m.*	*6·49*	*7·19*	*11·56*	*7·18*	*6·7 p.m.*	*8·34*	*9·10*	*1·15*	*6·32*				*Rest Day.*																*3·37 p.m.*	*8·4*	*8·40*	*11·2*	*6·49*
Early	8·51 a.m.	11·25	11·56	4·44	7·22	9·2 a.m.	1·53	2·41	5·31	7·44	7·38 a.m.	12·24	1·0	3·41	7·27	7·38 a.m.	12·24	1·0	3·41	7·27			Rest Day.			7·54 a.m.	12·42	1·29	4·19	7·48	8·26 a.m.	11·21	12·50	4·14	7·3
Late	*1·10 p.m.*	*4·49*	*5·49*	*9·28*	*7·33*	*3·29 p.m.*	*6·23*	*7·3*	*11·35*	*7·26*	*6·7 p.m.*	*8·34*	*9·10*	*1·15*	*6·32*	*6·7 p.m.*	*8·34*	*9·10*	*1·15*	*6·32*	*3·35 p.m.*	*6·23*	*7·22*	*11·47*	*7·27*			*Rest Day.*			*10·48 a.m.*	*1·21*	*1·54*	*7·15*	*7·54*
Middle	1·22 p.m.	5·55	6·34	8·57	6·56	10·41 a.m.	1·29	1·59	7·4	7·53																						Rest Day.		
Late	*5·1 p.m.*	*8·40*	*9·10*	*12·45*	*7·14*	*3·11 p.m.*	*5·54*	*6·41*	*11·5*	*7·17*																				*4·36 p.m.*	*6·58*	*8·58*	*1·1*	*7·40*
Early		Rest Day.				6·59 a.m.	11·36	12·6	2·47	7·18																				6·59 a.m.	9·14	10·6	2·50	7·6
Late		*Rest Day.*				*11·52 a.m.*	*2·41*	*3·11*	*8·2*	*7·40*																				*5·48 p.m.*	*8·22*	*9·30*	*1·7*	*6·34*
Early		Rest Day.				9·17 a.m.	2·11	2·59	5·49	7·44																				8·56 a.m.	1·49	2·53	5·14	7·33
Late	*1·17 p.m.*	*3·58*	*6·9*	*9·48*	*6·20*			*Rest Day.*			*3·35 p.m.*	*6·29*	*7·37*	*11·51*	*7·31*																*3·13 p.m.*	*5·34*	*6·10*	*10·38*	*6·49*
Early	8·32 a.m.	1·32	2·24	4·34	7·17	7·43 a.m.	12·30	1·6	3·47	7·28			Rest Day.																	7·40 a.m.	12·29	1·1	3·33	7·15
Late	*6·1 p.m.*	*7·17*	*7·59*	*12·35*	*5·52*	*3·53 p.m.*	*6·41*	*7·41*	*12·5*	*7·27*																				*3·54 p.m.*	*6·52*	*8·22*	*12·1*	*7·22*
Early	9·12 a.m.	12·4	12·38	5·8	7·22	8·0 a.m.	12·48	1·35	4·25	7·48																				8·3 a.m.	10·16	10·51	3·51	7·13
Late	*3·37 p.m.*	*5·47*	*6·58*	*11·48*	*7·26*	*4·29 p.m.*	*9·22*	*10·4*	*12·2*	*6·51*																						*Rest Day.*		
Early	7·52 a.m.	12·45	1·24	4·4	7·33	8·29 a.m.	1·18	2·5	4·55	7·49																				8·22 a.m.	1·9	2·13	4·33	7·26
Late		*Rest Day.*				*4·59 p.m.*	*7·41*	*8·52*	*12·55*	*7·11*																				*2·20 p.m.*	*5·43*	*7·21*	*10·44*	*7·39*
Early		Rest Day.				9·12 a.m.	2·5	2·47	5·37	7·43																				8·49 a.m.	1·40	2·39	5·8	7·34
Late		*Rest Day.*				*10·44 a.m.*	*3·53*	*4·36*	*7·15*	*7·58*																				*4·42 p.m.*	*9·10*	*9·52*	*11·50*	*6·26*
Early	8·52 a.m.	11·18	12·4	4·19	6·42			Rest Day.			7·28 a.m.	12·12	12·42	3·23	7·25																7·17 a.m.	11·57	12·29	3·3	7·14
Late	*4·11 p.m.*	*8·47*	*9·28*	*12·26*	*7·34*	*6·31 p.m.*	*8·52*	*9·22*	*1·25*	*6·24*				*Rest Day.*																*3·55 p.m.*	*6·16*	*6·58*	*11·23*	*6·46*
Early	8·12 a.m.	10·38	11·18	3·57	7·5	7·28 a.m.	12·12	12·42	3·23	7·25	7·43 a.m.	12·30	1·6	3·47	7·28															9·48 a.m.	12·44	1·21	4·19	5·54
Late	*5·37 p.m.*	*7·21*	*7·58*	*12·55*	*6·41*	*3·35 p.m.*	*6·29*	*7·37*	*11·51*	*7·31*	*6·31 p.m.*	*8·52*	*9·22*	*1·25*	*6·24*	*7·43 a.m.*	*12·30*	*1·6*	*3·47*	*7·28*			Rest Day.			8·0 a.m.	12·48	1·35	4·25	7·48	*8·7 a.m.*	*12·53*	*1·49*	*4·9*	*7·17*
Middle	12·3 p.m.	4·46	5·16	7·57	7·24	10·53 a.m.	3·47	4·30	7·9	7·43						*6·31 p.m.*	*8·52*	*9·22*	*1·25*	*6·24*	*3·53 p.m.*	*6·41*	*7·41*	*12·5*	*7·27*			*Rest Day.*						
Late	*3·58 p.m.*	*6·39*	*7·9*	*11·46*	*7·18*	*6·37 p.m.*	*8·58*	*9·35*	*1·43*	*6·30*																				*4·54 p.m.*	*9·22*	*10·10*	*12·8*	*6·29*

NOTES :—1. Monday to Friday duties are the same unless otherwise shown.
2. Staff change shift between Saturday and Sunday.
3. Pay Roll Week is from Wednesday to Tuesday, and each man gets a Rest Day in the Pay Roll Week, but not necessarily in the Shift Week, Sunday to Saturday.
4. Total time on duty includes any excess meal relief booked as working time.
5. The agreement does not define the starting or finishing times of late turn duties and many duties described as late actually finish before 9.0 p.m.

SECTION III

STATISTICAL DATA

SECTION III.

STATISTICAL DATA

In this section shall be produced the main statistical data collected, from which shall be based interpretation of the ways in which this work is liable to create an abnormally high rheumatic incidence.

In the main the data is set out in the form of a series of tables as follows:-

(3) Individual incidence figures 1936-1939.

(4) Monthly figures of appointments, absentees, attendances and treatments 1936-1939.

(5) A graph representing all the important points of Table IV and the clinic figures for 1931-1939.

(6) Estimated compared with actual figures 1936-1939.

(7) Discharge figures showing the results of treatment 1936-1939.

(8) Comparative figures for Central London Omnibus Workers against the Ministry of Health figures.

(9) Rheumatic Disease Incidence - Ministry of Health Inquiry.

(10) Occupation and Rheumatism - Males - Ministry of Health Inquiry.

(11) Details of 80 cases examined in greater detail.

TABLE III

INDIVIDUAL INCIDENCE FIGURES 1936 - 1939

The figures set out in this table (page 31) deal with the more detailed incidence of the individual rheumatic and allied conditions and have been compiled from cases all, with the exception of brief periods of absence, seen and examined personally and, therefore, while other investigators might conceivably have slightly modified some of the diagnoses made, the important fact remains that throughout these four years there is a relative consistency of diagnosis. This modification of diagnosis would probably apply with special reference to the fibrositic and neuritic group of cases which, as will be seen from reference to the figures, occupy the top places in incidence. For the purposes of this survey it has been adopted as a general rule that neuritis is only to be diagnosed in the presence of more than one of the following signs and symptoms:-

true nerve distribution of pain,
definite sensory involvement,
definite motor affection,
pain affected directly by change of temperature,
pain elicited on pressure over nerve points.

There have naturally been cases where some composite diagnosis has had to be made such as osteo-arthritis with secondary sciatica. In such cases note has been made of the condition under the separate heads. This serves to explain how the figures for the individual conditions are in excess of the figures for patients examined, and while, to take this example quoted above it may be argued that inasmuch as the patient is suffering from arthritis he is therefore prone to and likely to suffer from secondary neuritis and that therefore the case should be diagnosed only as arthritis. I cannot accept this view, more especially as I hope to show in the course of this survey that there are many and varied causes of neuritis, even in the presence of arthritis, affecting this group of men, causes which are almost specific to the nature of their work. In order that this may be brought out fully, therefore, I take the view that in all such cases the double diagnosis must be made.

The contractions with their meanings are:-

D. - omnibus driver.
C. - omnibus conductor.
I. - inspector.
N. - non-resident.
S. - inside staff.

The first three categories do not seem to call for any further explanation. As regards "non-resident" it should be explained that this term signifies a man who has previously been em-

ployed by the London Passenger Transport Board, but who has now transferred to another occupation, without ceasing to be a member of the L.G.O.C.Friendly Society. He is therefore still eligible for treatment at the Society's clinic, although having ceased to be in the employ of the Transport Board. As the number of these men actually seeking treatment is not large this does not constitute any real factor in the present investigation but the figures are included in order to preserve the completeness of the record. By "inside staff" is meant a man employed by the Transport Board, usually in a clerical capacity, and the main noteworthy point is probably that such a man represents as far as is possible an indoor worker as opposed to the others who work mainly out of doors.

The figures for each individual year have been recorded in the form of (1) the gross number of each condition found and (2) the percentage which this number bears to the gross number of conditions found during that one year. It will be noted that the figures for 1939 are recorded in type distinct from the previous three years. This is done because these 1939 figures have been estimated for the entire year by means of the actual figures collected during January to June of that year. It will be realised that the outbreak of International hostilities on 3.9.39, created a situation which was bound to have a distinctly disturbing effect on the veracity of any statistics collected after that date, inasmuch as they could not be compared directly with figures gathered over the same period during the previous three years. It seemed possible, however, in order to have the advantage of dealing with a complete four year period - and it must be admitted that the greater the period under examination the greater the relative accuracy of any inferences which may be drawn from the statistical data - that an estimation of the 1939 figures may be made by doubling the figures obtained from January to June 1939. In order to decide the practicability and possible accuracy of this estimation the previous three year figures were examined from this point of view and it was found that the error of estimated over actual figures ranged from -5% to +3.8%. It seems reasonable that this small margin of error should not detract from the accuracy of any inferences drawn from the estimated figures for 1939. Reference to Table VII (page 45) will show this estimation of error in detail.

Finally the gross total of each condition has been compiled and the percentage calculated to show the proportionate incidence of each condition over the entire period.

It must be borne in mind, when examining these figures, that the actual incidence shown is an under-estimate of the true gross incidence. This is in view of the fact that all the Society members are not bound to attend this clinic for treatment, and consequently many who have facilities more near at hand do not come here, and so are absent from the incidence figures. Bearing this in mind, therefore, it will be obvious that these figures are of more importance as a comparative rheumatic record than as an actual record of gross incidence.

TABLE III

INDIVIDUAL INCIDENCE FIGURES 1936 - 1939

CONDITION	1936		1937		1938		1939		Grand Total
FIBROSITIS.									
LUMBAR	D. 81 C. 46 I. 4 N. 1 S. 20	154. 24.87%	37 49 0 3 8	97. 16.8 %	65 54 2 4 8	133. 19.1 %	94 56 6 2 28	186. 25.8 %	570. 22.16%
OTHER	D. 42 C. 35 I. 1 N. 0 S. 2	82. 13.25%	39 25 0 1 4	69. 12.0 %	40 45 2 3 7	97. 13.3 %	80 38 6 0 18	142. 19.7 %	390. 15.17%
NEURITIS.									
SCIATIC	D. 42 C. 31 I. 3 M. 1 S. 11	88. 14.2 %	37 35 4 3 6	85. 14. 9	25 32 1 0 10	68. 9.8 %	16 10 4 4 16	50. 6.9 %	291. 11.32%
BRACHIAL	D. 31 C. 25 I. 1 N. 2 S. 7	66. 10.64%	42 29 5 4 9	89. 15.4 %	33 26 1 4 9	73. 10.5 %	28 24 0 0 12	64. 8.8 %	292. 11.36%
OTHER	D. 5 C. 3 I. 0 N. 0 S. 0	8. 1.3 %	9 8 0 0 0	17. 3.0 %	9 16 1 0 4	30. 4.3 %	6 4 2 2 2	16. 2.2 %	71. 2.76%
ARTHRITIS.									
OSTEO-	D. 21 C. 17 I. 2 M. 1 S. 4	45. 7.23%	19 32 4 4 5	64. 11.2 %	34 38 4 6 6	88. 12.6 %	38 38 6 4 10	96. 13.3 %	293. 11.41%
RHEUMATOID	D. 5 C. 7 I. 1 N. 0 S. 0	13. 2.1 %	9 1 0 0 0	6. 1.0 %	2 3 0 0 0	5. 0.8 %	4 0 0 0 2	6. 0.8 %	30. 1.16%

D = Driver. C = Conductor. I = Inspector. N = Non-Resident. S = Inside Staff.

TABLE III (continued)

INDIVIDUAL INCIDENCE FIGURES 1936 - 1939

CONDITION	1936	1937	1938	1939	Grand Total
RHEUMATISM.					
MUSCULAR	D. 11 C. 21 I. 2 N. 1 S. 3 38. 6.13%	8 11 0 1 3 23. 4.0 %	11 18 2 0 1 32. 4.5 %	8 16 0 0 6 30. 4.2 %	123. 4.71%
SUBACUTE	D. 1 C. 3 I. 0 N. 0 S. 1 5. 0.8 %	4 3 0 0 1 8. 1.3 %	5 1 0 0 0 6. 0.9 %	0 2 0 0 0 2. 0.5 %	21. 0.81%
GOUT.	D. 10 C. 8 I. 0 N. 1 S. 1 19. 3.0 %	4 3 1 1 4 13. 2.4 %	4 2 0 0 3 9. 1.1 %	10 8 0 0 2 20. 2.8 %	61. 2.37%
SYNOVITIS.	D. 7 C. 11 I. 1 N. 0 S. 1 22. 3.6 %	4 8 1 0 2 16. 2.8 %	12 16 0 0 1 29. 4.0 %	10 16 0 0 2 28. 3.9 %	95. 3.71%
PES PLANUS.	D. 8 C. 7 I. 0 N. 0 S. 0 15. 2.42%	8 8 4 0 0 20. 3.5%	5 23 0 1 1 30. 4.0 %	10 14 0 0 6 30. 4.2 %	95. 3.71%
UNCLASSIFIED.	D. 28 C. 35 I. 1 N. 1 S. 8 75. 11.8 %	11 5 0 0 4 20. 3.5 %	36 46 4 4 6 96. 13.2 %	18 18 2 4 8 50. 6.9 %	239. 9.31%
TOTAL:	628.	527.	696.	720.	2,571.

D = Driver. C = Conductor. I = Inspector. N = Non-Resident. S = Inside Staff.

TABLE IV

This table has been divided into four sections which cover the four year period 1936-39. Section "A" deals with the appointments made for patients to attend for treatment during each year. Section "B" deals with the number of absentees during the year. Section "C" deals with the actual recorded attendances, while Section "D" deals with the actual number of treatments given.

While the appointments and actual attendances are not perhaps figures of essential importance to the subject under investigation, they would seem to add useful data to the general prospectus. As a general rule we find that treatment is most beneficial when given on alternate days. There are, however, naturally certain cases where treatment is better when given daily or only once or twice weekly. There is one other factor which may be touched on here with regard to treatment. Many of these men are still continuing their work while attending the clinic for treatment. From this point of view the clinic is open most days until 8 p.m. and it is therefore possible for these men to arrange treatment during their rest days, off duty times or other suitable free periods. It will be admitted that, all other things being equal, this is an extremely helpful arrangement, as it does not necessitate the man's absence from work and does not therefore entail financial hardship on the patient due to lack of earning capacity. There is no doubt that a period of sick absence from work is prejudicial in some ways inasmuch as there is an element of nervous anxiety with regard to financial commitments and there is also, of necessity, a lessened food purchasing power in the household. This may affect not only the patient concerned but also the entire household, if it is carried on for any appreciable length of time. It will however be realised in view of the fact that many patients carry on both work and treatment simultaneously, that it is therefore not practicable nor wise to institute on these occasions any of what might be termed the more drastic forms of treatment. In other words a patient who is spending eight hours of the day at work cannot be expected to have the strength and time for a further two or three hours of intensive treatment. It is therefore necessary to limit the scope of treatment given to such patients. It is found, that the benefits to be derived from such a work with treatment arrangement are greatly in excess of the losses.

It will be noted that the figures for 1939 have not been recorded after June of that year except that an estimated grand total for the whole year has been produced. Reference to Table VII will explain how and why this has been done. It did not seem either necessary or practicable to estimate monthly figures for the second half of that year. One of the main purposes of recording these figures has been to stress, if possible, any seasonal incidence. This is dealt with more fully in the graphs set out next in these series.

TABLE IVa

APPOINTMENTS

	1936		1937		1938		1939	
January	856		718		850		763	
February	711	2,485	738	2,218	795	2,468	689	2,348
March	918		762		823		896	
April	733		980		674		744	
May	796	2,244	751	2,518	874	2,406	870	2,369
June	715		787		858		755	
July	862		773		861		4,717	
August	628	2,222	754	2,238	889	2,639		
September	732		711		889			
October	818		686		844			
November	767	2,350	837	2,267	943	2,525		
December	765		744		738			
TOTAL:	9,301		9,241		10,038		9,434	

TABLE IVb

ABSENTEES

	1936		1937		1938		1939	
January	68		53		71		85	
February	71	231	55	180	86	231	76	236
March	92		72		74		75	
April	55		66		51		80	
May	89	199	157	276	71	189	64	212
June	55		53		67		68	
July	78		56		52		448	
August	60	200	90	222	68	216		
September	62		76		96			
October	59		76		64			
November	53	199	100	282	65	249		
December	87		106		120			
TOTAL:	829		960		885		896	

TABLE IVc

ATTENDANCES

	1936		1937		1938		1939	
January	788		665		779		678	
February	640	2,254	683	2,038	709	2,237	613	2,112
March	826		690		749		821	
April	678		914		623		664	
May	707	2,045	594	2,242	803	2,217	806	2,157
June	660		734		791		687	
July	784		717		809			
August	568	2,022	664	2,016	821	2,423	4,269	
September	670		635		793			
October	759		610		780			
November	714	2,151	737	1,985	878	2,276		
December	678		638		618			
TOTAL:	8,472		8,281		9,153		8,538	

TABLE IVd

TREATMENTS

	1936		1937		1938		1939	
January	1,476		1,292		1,566		1,437	
February	1,290	4,240	1,339	4,034	1,407	4,498	1,337	4,604
March	1,474		1,403		1,525		1,830	
April	1,262		1,774		1,336		1,409	
May	1,232	3,646	1,138	4,287	1,612	4,405	1,782	4,724
June	1,152		1,375		1,457		1,533	
July	1,351		1,420		1,564		9,328	
August	1,090	3,708	1,235	3,825	1,675	4,764		
September	1,267		1,170		1,525			
October	1,466		1,170		1,591			
November	1,377	4,188	1,440	3,859	1,850	4,708		
December	1,345		1,249		1,267			
TOTAL:	15,782		16,005		18,375		18,656	

TABLE IVe

MONTHLY AVERAGE FIGURES

Year	Appointments	Absentees	Attendances	Treatments
1939	787.8	74.66	711.5	1,554.6
1938	836.5	73.75	762.75	1,531.25
1937	770.08	80.0	690.08	1,330.16
1936	775.08	69.08	706.0	1,311.0

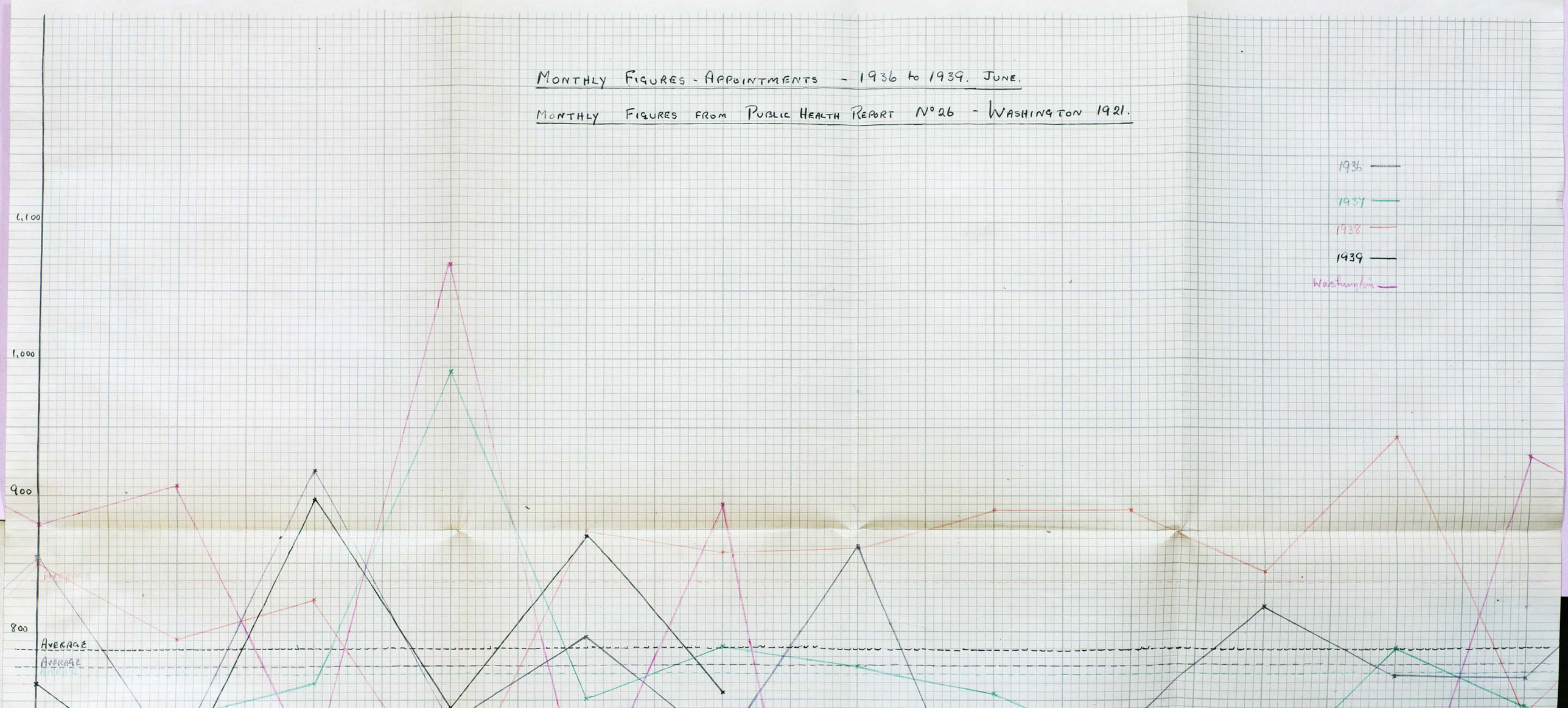
TABLE V

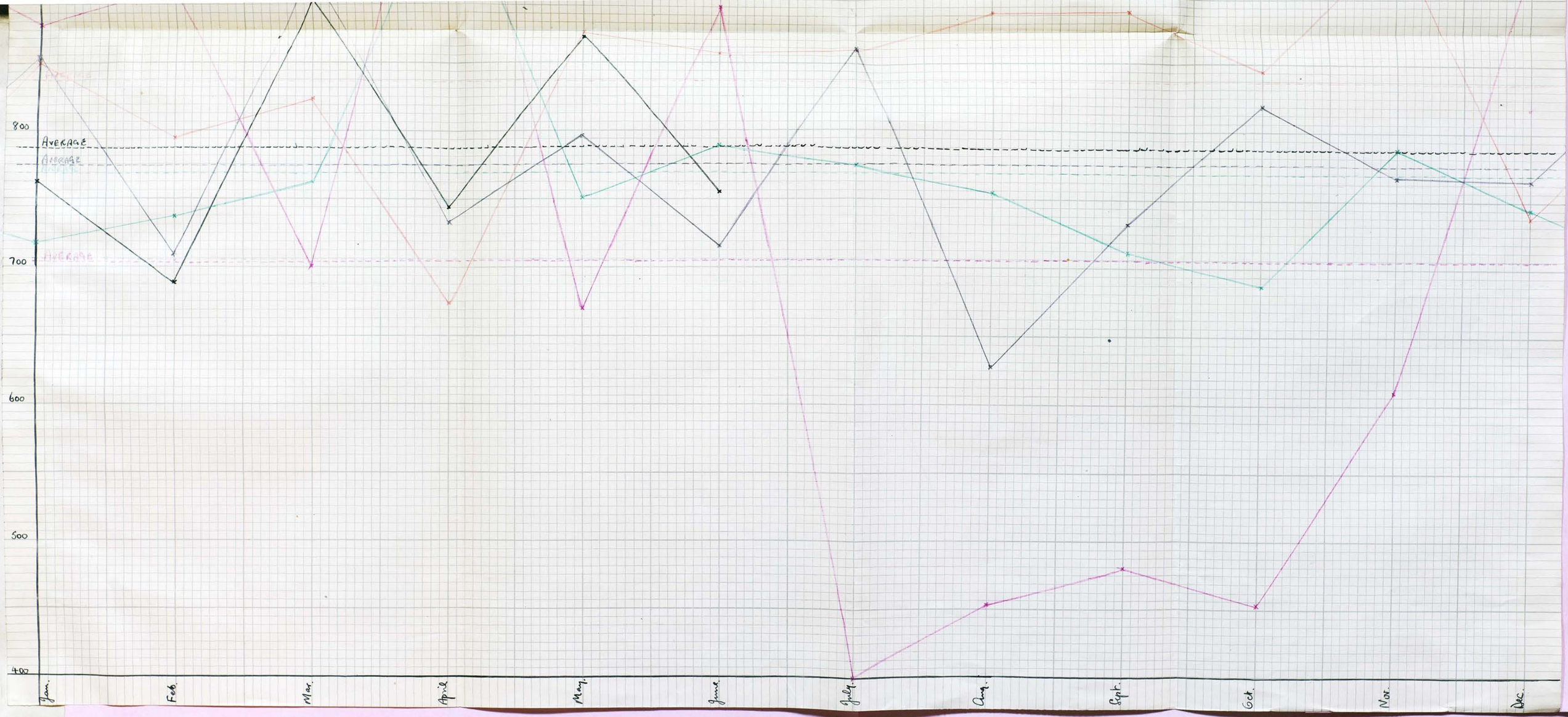
GRAPHS

The figures set out in Table IV have here been reproduced in graphic form and this has been done with a view to representing, if possible, the influence of any seasonal factors. It should be noted here that the period March to May 1937, is for reasons set out in Section IV, an exceptional period and undue weight should not be given to this period when interpreting the graphic results. Extensive search has been made in order to ascertain, if possible, any seasonal incidence reported (1) in any other industry and (2) in the general rheumatic figures. The most outstanding thing found during this search has been the lamentable absence of any statistical rheumatic data affecting other industries or the general public. The actual comparative figure used is obtained from the United States Public Health Reports.

MONTHLY FIGURES - APPOINTMENTS - 1936 to 1939. JUNE.

MONTHLY FIGURES FROM PUBLIC HEALTH REPORT N°26 - WASHINGTON 1921.




800
AVERAGE
AVERAGE
700
AVERAGE
600
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Feb.
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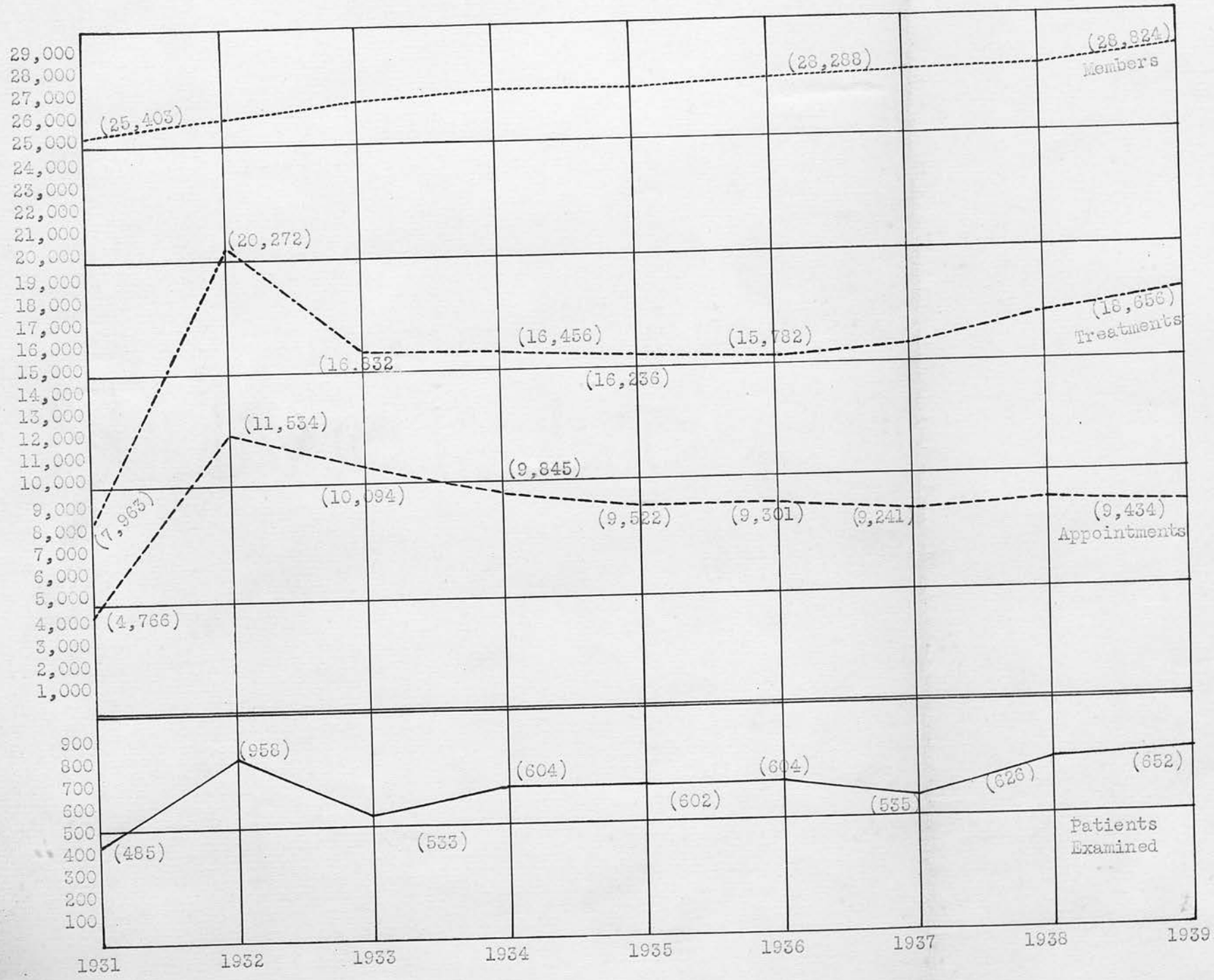
G R A P H 5B


29,000
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5,000
4,000
3,000
2,000
1,000
900
800
700
600
500
400
300
200
100
(25,403)
(28,288)
(28,824)
Members
(20,272)
(16,456)
(15,782)
(16,656)
Treatments
(16,832)
(16,236)
(11,534)
(9,845)
(10,094)
(9,522)
(9,301)
(9,241)
(9,434)
Appointments
(7,963)
(4,766)
(958)
(604)
(604)
(626)
(652)
(602)
(555)
(485)
(533)
Patients
Examined
1931
1932
1933
1934
1935
1936
1937
1938
1939

TABLE VI

In this table (page 43) the results are shown of an investigation of figures shown in Table IV. For the years 1936-1938 we have taken the first six monthly figures and compiled the gross total. By the simple method of doubling this total we have produced an estimated grand total for each individual year. In the second half of this table we have set this estimated yearly total against the actual yearly total in each case and have calculated the error of estimation over actual figures. As previously mentioned the error estimated over actual has ranged from -5% to +3.8%. This range of error does not seem of great import and it has been concluded from this that there is sufficient likelihood of a true result being obtained in 1939 to merit estimation of the whole year 1939 from the actual figures of the first six months. Use has been made of this estimation for 1939 in Tables III and IV.

TABLE VI (continued)

ESTIMATED v ACTUAL FIGURES

	Apnts.	Absts.	Attends.	Treats.	
1938					
	4,874	420	4,454	8,903	January to June
	9,748	840	8,908	17,806	Estimated Year
1937					
	4,736	456	4,280	8,321	January to June
	9,472	912	8,560	16,642	Estimated Year
1936					
	4,729	430	4,299	7,886	January to June
	9,458	860	8,598	15,772	Estimated Year
1938					
	9,748	840	8,908	17,806	Estimated Year
	10,038	885	9,153	18,375	Actual Year
1937					
	9,472	912	8,560	16,642	Estimated Year
	9,241	960	8,281	16,005	Actual Year
1936					
	9,458	860	8,598	15,772	Estimated Year
	9,301	829	8,472	15,782	Actual Year
1938	-290-2.8%	-45 - 5.0%	-245-2.6%	-569-3.0%	Error of Estimated over Actual
1937	+231+2.4%	-48 - 5.0%	+279+3.2%	+637+3.8%	Range of Error:
1936	+157+1.6%	+31 + 3.6%	+126+1.4%	-10-0.06%	-5.0 % to +3.8 %

TABLE VII

DISCHARGE FIGURES SHOWING THE RESULTS OF TREATMENT

1936 - 1939

In this table (page 45) we have set out the discharge figures from the clinic for the period 1936 to 1939. While this has no direct bearing upon the question of incidence and ætiology, it is of interest as a representation of the results which are obtained at the clinic by physiotherapy and electrotherapy. It will be noticed that I do not use the term "cured", but prefer the term "fit", which represents that physical state compatible with the efficient discharge of full working duties.

TABLE VII

DISCHARGE RESULTS 1936-1939

Discharges	1936	1937	1938	1939
Fit.	450	300	431	400
V.M.I.	106	99	97	192
I.S.Q.	48	30	38	38
TOTAL:	604	429	566	630

V.M.I. = Very much improved.

I.S.Q. = In status quo.

TABLE VIII

COMPARATIVE FIGURES FOR CENTRAL LONDON OMNIBUS WORKERS AGAINST THE MINISTRY OF HEALTH FIGURES

Here we have set out the detailed cases dealt with in this investigation, using the sub-divisions recommended by Glover. These figures have been reduced to a percentage of all the rheumatic cases. From these figures, and assuming that the entire membership represents the total number at risk, there has been constructed in column (4) the attack rates per 1,000 at risk. Here again, as previously noted, it should be remembered that this attack rate does not give a true gross representation of the amount of rheumatism occurring amongst these men. This is due to the fact that all these men do not necessarily attend for treatment at the clinic during a state of rheumatic disability. As has already been submitted, however, the attack rates now prepared form a comparative figure with regard to the individual incidence of the various subgroups included under the heading of chronic rheumatic conditions. This attack rate has been compiled from the four year period assuming that the total at risk was 113,000.

In columns (5) and (6) have been put the percentage of all rheumatic cases and the attack rate per 1,000 as set out by Glover in the Ministry of Health report on this subject. In order to obtain as true a comparison as possible, the attack rate constructed for the men at present under investigation has been readjusted, by calculation, to represent a total more directly comparable with the Ministry of Health attack rate. This attack rate is represented in column (7).

TABLE VIII

COMPARATIVE FIGURES

GROUP (1)		Total Cases (2)	% of all Rheum. Cases (3)	Attack Rates / 1,000 (4)	% all Rh. cases M. of H. (5)	Cases / 1,000 all Ages. M. (6)	Estimated Comparat. Rate/1,000 (7)
A.	1.	2	0.1	0.02	2.9	0.88	0.03
	2.	21	1.04	0.2	9.8	2.91	0.34
B.	3.	513	24.76	4.54	20.5	6.26	7.35
	4.	570	27.39	5.05	33.0	10.07	8.4
	5.	583	28.14	5.16	9.7	2.97	8.58
C.	6.	30	1.45	0.26	4.7	1.43	0.43
	7.	293	14.16	2.6	8.4	2.57	4.31
	8.	61	2.96	0.54	8.5	2.59	0.9
	9.	0	0.0	0.0	2.8	0.86	0.0
TOTAL:		2,073	100.0	18.35	100.3	30.54	30.54
		Total cases Omnibus Workers' group.	Percentage of all rheumatic cases - Omnibus Workers.	Attack rate per 1,000 at risk.	Ministry report % all rheumatic cases	Ministry cases per 1,000 all ages.	Estimated omnibus workers figures in comparison.

TABLES IX & X

IX. RHEUMATIC DISEASE INCIDENCE - MINISTRY OF HEALTH INQUIRY

X. OCCUPATION AND RHEUMATISM - MALES - MINISTRY OF HEALTH INQUIRY

These tables (pages 49 and 50) have been taken directly from the Ministry of Health report, Table X being slightly abridged. They form the only suitable and obtainable figures by which we may compare the rheumatic incidence amongst the London Omnibus Workers with that occurring in other industrial groups, and in the insured population in general.

TABLE IX

Sex and Age Distribution of all Cases of Rheumatic Diseases recorded in the Practitioners' Inquiry.

Attack Rates per 1,000 of Insured Population in each Age Group

Reference No. of Disease	Disease Number of cases (~~Ordinary~~) Attack Rates (~~Hourly~~)	Total Males	MALES					
			15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	Over 65
			Estimated population at risk in each age group:-					
			15,079	14,847	12,296	9,048	5,336	1,392
GROUP A. (1.)	Rheumatic Fever (acute Rheumatism)	51	23 1.53	8 .54	9 .73	8 .88	2 .37	1 .72
GROUP A. (2.)	Subacute Rheumatism	169	30 1.99	39 2.63	39 3.17	32 3.54	23 4.31	6 4.31
GROUP B. (3.)	Non-Articular Manifestations Muscular Rheumatism	363 (2 age not stated)	43 2.85	59 3.97	88 7.16	80 8.84	59 11.06	32 22.99
GROUP B. (4.)	Lumbago	584 (5 age not stated)	28 1.86	85 5.73	150 12.2	164 18.13	120 22.49	34 24.43
GROUP B. (5.)	Sciatica and Brachial Neuritis	172	3 .2	18 1.21	36 2.93	49 5.42	45 8.43	21 15.09
GROUP B. (6.)	Chronic Joint Changes Rheumatoid Arthritis (infective per-arthritis)	83	5 .33	5 .34	13 1.06	31 3.43	20 3.75	9 6.47
GROUP C. (7.)	Osteo-arthritis including Malum Coxae Senilis	149	2 .13	5 .34	21 1.71	21 2.32	51 9.56	49 35.2
GROUP C. (8.)	Gout	150	0 .0	2 .13	17 1.38	55 6.08	51 9.56	25 17.96
GROUP C. (9.)	Chronic Joint Changes unclassifiable	50	1 .07	3 .2	8 .65	16 1.77	15 2.81	7 5.03
	All Rheumatic Diseases	1,771	135 8.95	224 15.09	381 30.99	456 50.4	386 72.34	184 132.18

TABLE X

OCCUPATION AND RHEUMATISM - MALES (Abridged)

Number of male patients in certain occupations and the percentage distribution of occupations in each disease, compared with that of all occupied males over 10 in England and Wales, 1911

Occupation	Percentage of all occupied males in E. & W. 1911	Percentage all Rheumatic Diseases	Muscular Rheumatism	Lumbago	Sciatica	Rheumatoid Arthritis	Osteo-Arthritis
Clerks and Commercial	5.8	79 4.5	21 5.8	20 3.4	10 5.8	6 7.2	5 2.0
Conveyance of men, goods and messages	12.2	189 10.7	34 9.4	67 11.5	13 7.6	7 8.4	17 11.4
Agriculture on farms, woods and gardens	9.9	64 3.6	8 2.2	21 3.6	6 3.5	10 12.0	7 4.7
Mines, quarries	9.0	128 7.2	20 5.5	52 8.9	7 4.1	3 3.6	5 3.4
Metals, machines and implements	12.9	396 22.4	88 24.2	121 20.7	43 25.0	11 13.3	41 27.5
Building and works of construction	8.0	120 6.8	19 5.2	40 6.8	6 3.5	9 10.8	7 4.7
Paper, printing, etc.	1.9	22 1.2	8 2.2	3 .5	4 2.3	- -	1 .7
Textile fabrics	5.0	7 .4	- -	5 .9	1 .6	- -	1 .7
General labourers (part of)	2.6	242 13.7	49 13.5	98 16.8	18 10.5	13 15.7	19 12.8

TABLE XI

DETAILS OF 80 CASES EXAMINED IN GREATER DETAIL

The results have been recorded here of a more detailed investigation which was carried out in 80 of the cases examined at the clinic.

The points of outstanding interest in respect of rheumatism are the high percentage of previous rheumatism, either in the patient or in his parents, the high percentage of previous dental sepsis, and the high percentage of patients who have lost their natural teeth. The question of teeth, and its contained important factor of dental sepsis, is one of importance. However, inasmuch as it is not intended to submit that dental sepsis affects these men any more than it affects the population in general it is not of value to this present investigation to deal with this in detail. Suffice it to record, in passing, my view that on the average the tendency to have complete dental extraction carried out at an early date suggests firstly the great need for early, adequate and efficient dental care, and secondly that the greater institution of more conservative dental measures might meet with a more beneficial effect than the more drastic measures at present adopted. This brings in economic factors outside the scope of this investigation, and I shall leave this with the suggestion that a full investigation of the dental possibilities with especial reference to industrial disease is not only likely to be beneficial but is urgently required.

As regards dietetics it will be noted that practically all these men consume an average quantity of meat. There seems to me to be an inadequate consumption of milk, and this again is a matter which would merit more intensive investigation. There is also recorded a high percentage of constipation. To this we make further reference in Section V.

With regard to the Alkalinuria, which is found in more than half of these men, it should be remembered that many of these men are constantly taking some form of Alkaline stomach powder. This will have the effect of enhancing the presence of Alkalinuria, and again suggests that further investigation of this point might well give guidance as to whether acidification of the urine, by some such means as the internal exhibition of Acid Sodium Phosphate, might not prove beneficial in rheumatic cases either as a symptomatic or preventive measure.

TABLE XI

DETAILED ANALYSIS OF 80 CASES

Age Period
- 20 - 29 - 6.25%
- 30 - 39 - 35.0 %
- 40 - 49 - 27.5 %
- 50 - 59 - 25.0 %
- 60 - - 8.75%

Single - 3.75%

Married - 96.3 %

Children - Average - 2

Years of Service - Average - 16

Drivers - 43.75%

Conductors - 37.5 %

Prefers Previous Work 25.0 %

Rheumatism in Parents 30.0 %

Rheumatism in own family (including wife) 31.25%

Previous rheumatism in patient 52.5 %

Previous definite sepsis 36.25%

War Service (War 1914-1918) 66.25%

Illness during war service 32.5 %

Beer - None - 31.6 %
Average) Heavy) - 68.4 %

Spirits - Average - 5.0 %

Smoking - None - 14.5 %
Average) Heavy) - 85.5 %

Meat - None - 1.3 %
Average - 93.3 %
Slight - 5.3 %

Fish - None - 18.4 %
Average - 42.1 %
Slight - 39.5 %

Fruit - None - 29.8 %
Average - 48.6 %
Slight - 21.6 %

Milk - None - 36.6 %
Average - 47.3 %
Slight - 16.0 %

Vegetables - None - 4.0 %
Average - 90.8 %
Slight - 5.3 %

Constipation - 26.25%

Sweating marked - 15.0 %

Teeth
- All natural - 39.5 %
- All false - 40.8 %
- Intermediate - 19.7 %

Dental Sepsis present - 20.0 %

V.D.H. - 12.5 %

Chr. Bronchitis - 45.0 %

Proteinuria - 7.5 %

Glycosuria - 1.3 %

Urine
- Acid - 16.25%
- Alkaline - 52.5 %
- Neutral - 31.25%

(N.B. Many of these men constantly take alkaline stomach powders - a possible cause for the high alkaline figure here.)

SECTION IV

ÆTIOLOGY AND PATHOLOGY

SECTION IV.

AETIOLOGY AND PATHOLOGY

In this section it is proposed to interpret in more detail the figures set out in Table III, Section III. We shall examine each condition mentioned in ~~different~~/tables and shall set /the out in general what is meant by each condition and the generally accepted views with regard to aetiology and pathology of each individual condition. In this way we shall be able in Section V to draw conclusions as to what factors already known to act in a possible causative way are more predominant in their presence and action in the group of workers under consideration.

FIBROSITIS.

It will be seen that this forms the greatest single group with regard to incidence figures and, with the exception of 1937, no other separate condition exceeds the numbers found here.

The term fibrositis has been in general and increasing use ever since it was first introduced to medical literature by Sir William Gowers (40). In the course of usage it has tended to develop a much too wide and loose application and there has been, and still is, a great tendency to use this word as a term for any and all aches and pains in the back and other places, without due care being taken to eliminate all other diagnostic possibilities. In strict application, its use should be limited to the indication of a non-suppurative inflammation of white fibrous tissue. This may affect subcutaneous tissue, nerves, muscle sheaths and septa, ligaments, fascia lata, plantar and palmar fascia, muscle insertions, tendon sheaths and any other places where such white tissue is to be found. It is mainly distinguished by pain on stretching, either actively or passively, with tenderness on localised pressure. There is usually stiffness on movement and on palpation of the affected part, the greater or lesser presence of nodules and thickenings can be elicited. Even in this there is still room for confusion and there is much truth in the expressed view of Poynton and Schlesinger (75) that "the whole subject is confusing and bound up with the close relationship between fibrosis and fibrositis, fibrosis being the end-result of a chronic fibrositis". As regards morbid histology and pathology the acute stage of this condition presents a low grade œdema with a sero-fibrinous exudate. Stockman (88) found newly formed fibrous tissue with this œdema, and many fibroblasts and numerous blood vessels with new capillaries. He noted an entire absence of any leucocytic reaction. In the chronic stage he found new fibrous tissue lying in an amorphous matrix, with few fibroblasts and no congregation of leucocytes. The smaller vessels show thickening of all their coats and Poynton found perivascular fibrosis. It is in this stage that one usually finds the indurated

areas and aggregations which have received the name of "fibrositic nodules". Inasmuch as the size and site of the involved area varies it follows that there must be great variety in the shape, size and tenderness of these nodules while there will be times when they cease to represent themselves as actual nodules but become instead actual areas of induration. Much doubt and uncertainty still surrounds this actual nodule and until such time as it may become more easily possible to dissect out such a nodule from the muscle bundles this doubt must remain.

As regards æetiology there are several outstanding possible factors:

(1) SEPSIS. Cases are on record where a fibrositis has arisen therefrom and been directly attributable to some then present frank sepsis, such as acute septic tonsils, acute cholecystitis, cervicitis etc., and of these conditions there is no reasonable doubt. This type, however, usually reacts rapidly and completely to treatment of both the sepsis and the relative fibrositis, and the only difficulty in such cases is that it is sometimes found that once the fibrositis has commenced it may be followed by further attacks in other parts of the body due to a secondary deposit of toxin, or even in the absence of such toxin. The latter also applies to the more important form of sepsis - as affecting more chronic fibrositis- namely chronic focal sepsis. Here again such possibilities as septic tonsils come in for their share of blame, and whatever view one may take of the veracity of this blame, the fact remains that many cases are on record where the removal of chronically infected tonsils has certainly brought about a speedy cessation of the fibrositic symptomatology. One outstanding possible source of focal sepsis would seem to be the teeth.

(2) COLD AND DAMP. The effects of cold on the human body are produced through reflex contraction of the skin vessels and contraction of the blood vessels in the underlying voluntary muscles. This disturbance of capillary circulation leads to autonomous capillary contraction with subsequent capillary congestion. Congestive hyperæmia and serous transudation follow on this and give rise in the main to the local signs and symptoms, such as the previously mentioned œdema. This has been substantiated by experiments set out to show the lowering of the skin temperature over the affected area with the relative effect of constriction, obtained on capillary microscopy. The main factors active in this chilling are a low temperature, draught, moisture and immobility of the affected part. The draught on the skin causes a withdrawal of heat, and should there be the presence, at the same time, of dampness such as may be obtained from rain or sweat, this chilling effect will be further enhanced by the consequent process of evaporation. Such chilling effect is not so much dependent upon the size of the area involved as rather on the duration of the subjection.

(3) METABOLISM AND FATIGUE. Here we bring in a wide field of possibilities which serve in the main as adjuvant factors to those previously mentioned and to the factor of posture and strain discussed below (sub-section 4). In the state of fatigue there

is a tendency to allow the muscles to suffer from inadequate use and this allows for the greater accumulation of effete material which would normally have been eliminated in the course of active muscular exercise. On the other extreme there is the possibility of fibrositis following upon the over active or unusual use of muscles. There is also the local type of muscular fatigue where in certain occupations you get a great prolonged over use of a certain group of muscles - the condition and state now recognised in such things as writer's cramp and shoemaker's thumb. It will be remembered, also, that in the course of active muscle action "oxygen debt" is built up, against such times as there will be a chance to restore the normal balance. Full and adequate restoration becomes more difficult in direct proportion to length of continued active muscular action.

(4) POSTURE AND STRAIN. If we recall to mind the main principles of muscle inbalance this factor will become more clear. Delicate balance is required and expected between opposing groups of muscles for the correct performance of any movement or in the maintenance of correct posture. This balance can be easily upset either by insufficient or excessive use of any one group of muscles, or by alteration of the normal length of the muscle fibres. Wesson (95) notes that when a muscle is lengthened for any considerable period the tendency is for the fibres to be atrophied, while a shortened muscle tends to become stronger and fixed in its shortness. Such changes occur not only in the muscle fibres but also in the non-expansile connective tissue. This will lead to a condition whereby certain groups of muscles, depending upon the actual posture adopted by the man in the course of the muscle exercises, will tend to become permanently shortened with a corresponding shortening of the contiguous connective tissue. This is dealing with men whose occupation entails the adoption and maintenance of some postural position for a long period. Having developed this state it is obvious that the slightest sudden strain put on these muscles, as may possibly be occasioned by a slip or sudden small movement, will cause an acute stretching of a tissue group, which has by virtue of its shortening become less able to expand and so to compensate and allow for such stretching. In consequence there will be set up the symptoms of over-stretching or spraining of the part, even though the actual causative factor has been no more than the particular group of muscles ought normally to have been able to withstand without any deleterious results, and when we come to apply this principle more directly to the omnibus driver the position becomes clear. The man spends the main part of his working day sitting with the hips and knees flexed practically to 90 degrees. This results in a marked and prolonged relaxation of the ham-string muscles and stretching of the glutei. The result of this is to produce a more than transient shortening of the hamstrings and a corresponding lengthening and atrophy of the gluteal muscles. This will have the effect of a downward pull on the posterior pelvis with flattening of the lumbar spinal curve, and with consequent loss of its mobility.

Now upon such a state it follows that any sudden strain, such as the sudden application of the foot brake or clutch will lead to an acute strain on the ham-string muscles and a secondary strain upon the sacro-iliac joint and its ligaments. A further point of interest, while not being actually related to this present condition, is to note that this strain may be followed rapidly by the onset of sciatic symptoms. This serves as a good example of the often repeated statement that sudden strain upon the sacro-iliac joint and its ligaments is often the true cause of a sciatic pain. Before leaving the subject of fibrositic aetiology it would be as well to note that in all cases efforts should be made to cut out the possibility of an underlying condition of which the fibrositis is but the outward manifestation. In this way it will be possible to avoid diagnosing fibrositis per se when such conditions as arthritis, subluxation of joints, vagotonic vascular disease etc. are really the causative factors. The possibilities of psychopathic fibrositis will be dealt with under the heading of nervous manifestations.

Traeger (91) indicated chills, fatigue, trauma, chronic strain, nervous exhaustion and infections as the main precipitating causes, while Buckley and Gordon considered metabolic toxins as the more likely cause.

If we adopt the classification used by Glover (35) in his report on the chronic rheumatic diseases we find that the fibrositis groups which include what we have in Table III classed as lumbar fibrositis, other fibrositis, occupy the second highest incidence position. Reference to Table VIII shows us that in comparison with the attack rate found by Glover there is a slight decrease in the amount of lumbar fibrositis with an increase in the amount of other fibrositis and muscular rheumatism. It is a common finding that the incidence of fibrositis in all forms increases with age and again we turn to Glover's figures in this respect. His attack rate per thousand insured males divided into age group was as follows:-

MEN.	Age	16	- 24	..	5
		25	- 34	..	11
		35	- 44	..	22
		45	- 54	..	32
		55	- 64	..	42
		65	-	..	63.

The age groups under consideration in this series range from 25 to 65. The incidence in these series has not been distinctly separated into the individual age groups set out by Glover, but the fact remains that for general fibrositis, excluding lumbar, the attack rate here has an increase over what we might term the expected rate.

With regard to aetiological factors of more especial application to the group of men under consideration we have here to consider:-

Sepsis - (a) direct. (b) indirect. (c) chronic focal.
Cold and moisture.
Metabolism and fatigue, with their reference to the accumulation of effete material, oxygen debt and over-strain of particular muscle groups.
Posture and strain with their reference to long strain in a set position leading to contraction of muscles.
Vulnerability to sudden strain, even small, resulting from contraction of muscles as indicated above.
Flattening of the lumbar curve.
Nervous Manifestations - this we will deal with in more detail on page 82.

NEURITIS.

This group forms the second largest group, as shown by the incidence figures, and the Neuritides for the purposes of classification in this work have been divided into Sciatic, Brachial and Other Neuritis. It has been found that the cases of neuritis met with in this work are almost entirely of the local or interstitial type, as opposed to multiple neuritis of toxic or other origin. When such cases of multiple neuritis have been found they have been grouped under the third title of Other Neuritis, which also includes neuritis occurring in other anatomical areas than those supplied by the sciatic or brachial plexi. We shall, in more detail, deal with neuritis as affecting the sciatic and brachial plexi.

SCIATICA.

Anatomically the sciatic plexus arises from the anterior divisions of the 5th lumbar and 1st and 2nd sacral nerves, with smaller branches from the 4th lumbar and 3rd sacral nerves. The brachial plexus arises from the anterior rami of the 5th, 6th, 7th and 8th cervical with a greater part of the 1st thoracic and communications from the 4th cervical and 2nd thoracic nerves. Histologically the local neuritis, which is the type mainly of interest here, is an inflammation of tissue surrounding and connecting the nerve fibres, plexi and peripheral nerve trunks. Particular areas have been from time to time singled out and have acquired particular names. An example of this is the term Radiculitis which is a neuritis of the nerve in the spinal canal as it passes through the intervertebral foramen. The affected nerve becomes swollen and hyperaemic, and later firm and hard from resultant fibrositis. There is a round celled infiltration of the perineurium and endoneurium, a proliferation of fibroblasts and an exudation of lymph. A later stage may be found with fibrosis and degeneration of the myelin sheath.

Symptomatically there is usually pain of a dull aching type, tenderness on pressure over the affected nerve or its branches, and there is usually a lesser or greater sensory disorder. This typically takes the form of numbness over the area supplied by the affected nerve and sometimes hyperæsthesia. In a fully developed and chronic case there may be motor disability. The tendon reflexes are usually increased at first and may later become diminished or even absent with wasting and fibrosis or early in the presence of a very acute attack.

As regards aetiology there is a large and varying number of possible causes and in the main the causes are similar in either the brachial or sciatic group. We shall, therefore, in aetiology deal primarily with sciatica and avoid the redundant repetition caused by examining both groups individually.

Sciatica may be divided into four aetiological areas:

1. Involving the nerve roots in the spinal canal.

   This may be due to:-
   - (a) Bone deformity.
   - (b) Bone fracture.
   - (c) Dislocation of a vertebral body.
   - (d) Groups of osteophytes in the spinal canal.
   - (e) Herniation of the necleus pulposus.
   - (f) Meningitis.
   - (g) Neoplasm.

2. Involving the nerve in the intervertebral canals or foramina.

   This may be due to:-
   - (a) Bone deformity.
   - (b) Injury to an intervertebral disc.
   - (c) Inflammation of an intervertebral joint.

3. The nerve may be involved in its course through the pelvis.

   This may be due to:-
   - (a) Bone deformity.
   - (b) Fibrositis.
   - (c) Sepsis.
   - (d) Neoplasm.
   - (e) Sacro-iliac strain.
   - (f) Chronically over-loaded colon.

4. In its passage down the leg.

   This may be due to:-
   - (a) Bone deformity.

(b) Cold.
(c) Pressure.
(d) Trauma.

BRACHIAL NEURITIS.

It will be obvious that with adjustment to suit anatomical and other differences these various possible causes can be applied equally to the brachial group.

Before dealing with any of these possibilities in detail it is of interest to note one or two expressed views regarding this subject.

Cohen (17) notes a form of sciatica due to what he terms "rheumatism". In the absence of any clear definition as to what "rheumatism" means this does not lead us very far. He talks of this sciatica as a lesion allied to fibrositis, and he notes that nerves and muscles have a fascial covering. This contains a small space lined with mesothelium that allows a gliding movement to occur. Adhesions in this space would naturally interfere with movement and cause pain.

Critchley (22) stresses a type of sciatica where, for example, in commercial travellers sitting in badly sprung small cars, minor traumata and abnormal posture create a varicosity of the veins draining the nerve trunks.

Mennell (61) stresses the possibilities of focal sepsis as an ætiological factor.

Harris (45) singles out a sciatica caused by direct chill to the buttock from sitting on a damp seat, and also from prolonged pressure from a hard surface and he notes that the "rheumatic type" does not usually show muscle wasting except in the very long standing cases.

Buckley (6) agrees with Critchley on the importance of sciatica arising from the driving of a car.

In the differentiation of sciatica it is found that absence of the knee jerk is indicative of involvement of the anterior crural system, and the lesions must be sought in the spine. Where Achilles jerk is unaffected - the sciatica is of the high type, that is a lesion above the level of the sciatic notch, and the lesion is usually to be found in the neighbourhood of the intervertebral foramina around the 4th and 5th lumbar nerves. The point being that the Achilles jerk is dependent upon the 1st sacral root and is, therefore, not affected by a lesion of the 4th and 5th lumbar nerves. In greater detail we shall discuss some of these ætiolo-

gical possibilities in view of their outstanding importance to this group of men. In the case of intervertebral disc disorders this represents a somewhat recent addition to the literature, and is consequently worthy of special mention.

PROLAPSED INTERVERTEBRAL DISCS.

While it is only in recent years that much work and interest has centred around this possibility, reference to the literature shows that Virchow (94) as early as 1857 referred to a traumatic extrusion of cartilage from an intervertebral disc. Notice was not directed to this until 1911 when Goldthwait (37) stressed the importance of intraspinal extrusion of disc tissue with compression of cauda equina. In that same year Middleton and Teacher (62) described a case where rupture of a disc had been brought about by muscular effort.

In the succeeding years more and more work has been done in this connection until we have arrived now at a stage where the possibilities are clear, the diagnosis is becoming clear, the treatment is clear but the actual relative proportionate incidence which this type bears to all sciatica is not yet sufficiently clear, nor the pros and cons of when and when not to resort to surgery. The reason being that sufficient time has not yet elapsed for the early hyperenthusiasm to give place to sound judgment backed up by carefully collated case figures and reports.

Anatomically there is found between each two vertebrae a fibro-cartilaginous plate or intervertebral disc whose function is, in conjunction with the cerebro-spinal fluid, to act as a shock absorber and a protection for the delicate spinal cord and cauda equina. Normally the disc does not project into the spinal canal, but under conditions of stress and strain the disc may bulge beyond its usual area. Provided that the spine is not abnormal the disc assumes its normal relationship to the spine on the cessation of effort. It is retained in place by the anterior and posterior longitudinal ligaments. The disc consists of two separate portions though connected intimately, the nucleus pulposus a resilient semi-fluid substance situated in the central portion of the disc, and the annulus fibrosus an outer circular fibro-elastic structure. Under conditions of abnormal stress and strain the disc may project abnormally into the spinal canal with consequent compression of the cord or one or more spinal roots.

A history of trauma frequently precedes the onset of symptoms, and while some considerable time may elapse it is usual to find a history of pain following injury to the spinal column. In many cases, however, it may not be possible to elicit any one

outstanding injury, but repeated trauma with aggravation of pre-existing pain and disability. It may well be therefore - as is the view of Love - that the original injury weakened the longitudinal spinal ligaments, while the actual protrusion of the disc substance occurs at the time of a subsequent injury which may have been less severe than the original one.

Love (35) has concluded, from a comprehensive pathological and anatomical study of many of these cases, that:-

1. "Posterior protrusions of the intervertebral discs, causing clinical symptoms which lead to operation, are composed of all parts found in the normal unprotruded inververtebral disc; the annulus fibrosus, including its outer parts, and the nucleus pulposus, with its occasional remnants of the embryonic notochord.

2. The tissue of the intervertebral disc is almost invariably altered in the protrusion. The common and constant changes in it consist of structural alterations of the normal architecture of the disc.

3. Degenerative changes also are very commonly seen. Advanced degeneration is more frequent in cases of protrusion occurring in the older age-group. Marked degeneration of the cartilage cells is much more frequent than degeneration of the fibrils.

4. Fibrosis may occur either in the form of proliferating fibrous tissue or in close relationship with remnants of the notochord. In both cases, the fibrous tissue tends to replace the normal fibrocartilaginous structures of the protrusion.

5. Œdema of the protruded part of the intervertebral disc is a most important and frequent finding. It may involve the annulus as well as the nucleus and is more frequent in young individuals.

6. The œdema of the protrusion must be considered as a result of the capacity of the nucleus pulposus to swell, if the normal forces keeping it in place and shape are decreased. At the same time, it may be helped or held back by circulatory changes resulting from the displacement of the protruded part.

7. The occurrence of œdema may result in exacerbation of the clinical symptoms. Such an exacerbation may, however, subside either spontaneously or because of conservative treatment.

8. From this study it is not possible to draw any conclusions about the relationship of notochordal rests to the aetiology of the protrusion of intervertebral discs."

The symptomatology and clinical findings do not show sufficiently outstanding points of difference to make the diagnosis of protrusion of intervertebral disc possible before a true exploration of all other sciatic possibilities, and Love puts it this way:-

> "when an individual presents himself for examination with a chief complaint of low back and sciatic pain which has not responded to conservative treatment, a protruded disc in the lumbar region is the diagnosis most likely to be correct if there is a scoliosis, limitation of spinal motion, loss of lumbar lordosis, positive Laseque's and Kernig's signs, sciatic tenderness and diminished or absent Achilles tendon reflex."

Barr (2) has summarised his findings in over 100 verified cases of lumbar intervertebral discs in the interesting table on the following page.

TABLE

	Per cent.
Location of lesion:	
Disk between L4-5	50
" " L5-S1	35
" " L3-4)	
" " L1-2)	10
" " L2-3	5
History of injury:	
(a) Immediately preceding disability	50
(b) Latent period preceding disability	30
Total	80
Type of injury:	
Lifting a heavy weight	50
Falls from a height)	
Twisting strain }	30
Miscellaneous)	
No known injury	20
Pain:	
Constant from onset until operated upon	60
Remissions and relapses	40
Areas to which pain was referred (unilateral 80 per cent; bilateral 20 per cent):	
Posterior and lateral thigh	95-100
Postero-lateral calf	90
Lumbo-sacral region	70
Gluteal and sacro-iliac regions	65
Lateral border of foot	5
Signs:	
Positive Lasègue (limitation of straight leg raising)	100
"Sciatic scoliosis"	60
Reversal of lumbar curve (kyphos or flat back) ..	90
Local tenderness over the lumbar spinous processes	50
Radiating pain on coughing, sneezing, or jugular compression	40
Neurological signs:	
Absent or diminished ankle-jerk	50
Sensory change in the extremity (anaesthesia or hypo-æsthesia)	35
Motor changes (weakness or paralysis)	15
Sphincter disturbance	5
Lumbar puncture:	
Total protein content above 40 mg. per 100 c.cm. ..	85
Total protein content below 40 mg. per 100 c.cm. ..	15
Dynamic evidence of block, whether partial or complete	10
Cytological changes in spinal fluid	rare

This table is a statistical summary of data obtained from a study of the records of over 100 verified cases of lumbar intervertebral disk ruptures into the spinal canal.

As regards investigation these patients should have an examination of cervical spinal fluid. The outstanding findings in this type are increased protein content and, particularly in compression above the lumbar region, the presence of spinal subarachnoid block (Queckenstedt's Test). This is followed by lipiodol radiography of the spinal tract, by which means it is possible in the majority of cases to show the presence of disc protrusion. In his series of cases Love maintains an error of less than 10%. The curative treatment of protrusion of an intervertebral disc is the surgical removal of the fragmented and protruded portion of that disc through a laminectomy approach. According to the surgeons versed in this procedure the operative risk is slight. An extradural approach is the one usually employed and it is advisable to leave the meninges unopened while removing the protrusion. The entire disc is never removed and it is not found necessary to place any bone graft in the site of operation. If severe damage has been caused by the protrusion, residual symptoms and signs may persist but this is not the usual finding. Love (35) records in a report on this condition that patients operated on as long ago as 1922 have since remained well.

BONE DEFORMITY.

With regard to bone deformity the most outstanding possibilities here are:-

A sacrolized 5th lumbar vertebra.
A separate 1st sacral vertebra - sometimes termed "a 6th lumbar vertebra".
Sacro-iliac subluxation (post traumatic).
Bone diseases causing deformity, including such outstanding conditions as:-
- Osteitis Deformans.
- Tuberculous caries.
- All bone malignant diseases, either primary or secondary, giving rise to what has been termed "malignant sciatica".

Osteo-arthritis. This can create trouble either from direct pressure of osteophytes or direct spreading of the inflammation.

In dealing with the 5th lumbar nerve it is of interest to note the consideration put forward by Putti. He points out, in relation to the funicular portion of the 5th lumbar nerve as it lies in the foramen, that it is situated in a fibro-osseous canal. He notes that this 5th root, surrounded by a thick venous plexus, practically fills the entire available space in the canal. The walls of the canal are bounded posteriorly by the posterior spinal articulation, antero-internally by the intervertebral disc, and postero-externally by the lumbo-sacral and ilio-lumbar ligaments. Close to the lateral aspect of the posterior articulation runs the dorsal primary division of the nerve as it turns backwards to supply

the sacrospinalis muscle and the joint capsule. It follows, therefore, from these relations that the 5th lumbar nerve is in a position of outstanding vulnerability, and may easily be affected adversely by trauma of the lower back involving the lumbo-sacral articulations and by inflammation of these areas.

Cochrane (16) commenting on this notes that the slight margin of safety present by reason of the function of the normal muscular support is further jeopardized by anatomical variations of the lumbo-sacral region, causing either increased motion at the expense of stability, or producing abnormal stresses.

Steindler, after examining a large group of cases of sciatica, found anatomic variations in the lumbo-sacral region of no less than 37%.

COLD, DAMP, PRESSURE.

It should be clear from the information and data supplied in the proceeding sections that such factors as cold, pressure, trauma and sacral lumbar strain are of tremendous importance in a consideration of the neuritides as affecting this group of men.

BACKACHE.

In close connection with, if not indeed inseparable from, this picture presented of fibrositis and neuritis must be considered the picture of "backache". In a discussion of this condition Mennell (60) points out the most likely causes as follows:-

Haemorrhoids.
Gynaecological abnormality.
Post-operative.
Tumours of the Cauda Equina.
Sepsis - either acute or chronic.
Malignant disease of the spine.
Bone Disease
- Metastases.
- Osteitis Deformans.
- Osteoporosis.

Joint Disease
- Tuberculous.
- Arthritis (traumatic and other)
- Inflammation (trauma etc.)
- Spondylitis.
- Sacro-iliac (locking)

Postural Defects

1. Lordosed back
   - Sacralized 5th lumbar vertebra.
   - Obesity with laxity of the abdominal muscles.

2. Flat back.
3. Tilted pelvis.
   Congenital.
   Due to hip disease.

Gormley [33] and McDeed [56] have made more detailed tabulations of the causes, but introduce no factor not mentioned in the above classification.

Further causes of postural defects are abnormalities of the feet, a shortened tendo-Achilles and what has been termed "the motorist's spine", brought about by a flattening of the lumbar curve with strain on the sacro-iliac areas.

With regard to the foregoing list in particular, the question of gynæcological abnormalities does not, obviously, concern us here. The post-operative type of back is usually due to a flattening of the lumbar curve due to inadequate protection for its support on the operating table and this type is in direct relationship to the motorist's spine also noted.

Such then are the main possible æetiological factors to be considered in any interpretation of the incidence figures for fibrositis and neuritis and opportunity will be taken in Section V to point out where possible, the more outstanding factors in relation to the type of work and the working conditions in this group of men.

The neuritic group which is group B5 in Glover's classification, includes brachial neuritis and sciatica. It is found that, using Glover's attack rate as the expected figure, the incidence in this series shows a very marked increase over the expected rate. Again the general finding is that increasing age tends to increase the incidence figures.

With regard to æetiology, as more primarily affecting the men under consideration, we can set out the following factors as being of more especial interest:-

Osteophytes in the spinal canal.
Joint involvement.
Fibrositis.
Sepsis.
Sacro-iliac strain.
Constipation.
Cold.
Pressure.
Moisture.
Trauma.
Intervertebral disc complications.
A "motorist's spine" - mentioned by such authorities as Mennell [59], Critchley [22] and Buckley [7].

ARTHRITIS.

In the group of men under consideration there has been recorded in Table III the figures relative to the incidence of osteo-arthritis and rheumatoid arthritis, and it is to be noted that osteo-arthritis preponderates approximately in the proportion of 10 to 1.

Before dealing in detail with this condition it is necessary to make reference to the vexed question of nomenclature. Many names have been concocted for the various arthritic phenomena but perhaps the greatest cause for dubiety and multiplicity in the nomenclature has been the difficulty in establishing the aetiology, pathology and histology of these various conditions. Many authorities hold the view that rheumatoid arthritis and osteo-arthritis should be considered as separate diseases. On the other hand Knaggs (52), Willcox (96), Clawson and Weatherby (15) take the view that they are different expressions of the same disease, while Pemberton, Osgood, White (73), Poynton and Schlesinger (75) take the view that they are separate clinical conditions having the same common or allied cause. Poynton and Schlesinger suggest as classification merely rheumatoid arthritis and osteo-arthritis as two sub-divisions of the main heading Arthritis Deformans. Glover in his classification of the rheumatisms generally, a classification now very widely adopted, divides the chronic arthritic group into:-

1. Rheumatoid arthritis.
2. Osteo-arthritis.
3. Gout.
4. Unclassified arthritis.

The Committee of the Royal College of Physicians of London, while dividing all forms of chronic arthritis into the rheumatoid and osteo-arthritic types, further sub-divided these two types into known and unknown aetiological variations.

I hope in this section to put forward views, corroborated by authorised findings to indicate that rheumatoid arthritis is paramountly of infectious aetiology while osteo-arthritis bears aetiological relationship to infection only inasmuch as the arthritis has arisen directly due to lymphatic stasis and this has been brought about by fungal infection. Admittedly, therefore, osteo-arthritis should theoretically be classed as of infectious aetiology; but the difference is that the infection in rheumatoid arthritis is in direct relationship to the joint condition, whereas in osteo-arthritis the infection leads to a lymphatic stasis which in its turn brings about osteo-arthritis as a purely degenerative result.

The simplified classification of Poynton and Schlesinger seems to be the most helpful, and I would only add to it Glover's (35) fourth sub-division, that is unclassified arthritis. This is suggested in view of the fact that it is at times impossible to decide with any degree of certainty whether a particular case of arthritis has more of an osteo or rheumatoid element in it. In other words

there is a condition where the two types intermingle to a greater or lesser extent. Glover's third sub-division headed gout is more distinctly a separate and usually primarily metabolic condition and can be with advantage left out of this chronic arthritic discussion.

With regard to the actual cases examined, and from which the figures in Table III have been obtained, the division was distinctly into the two classes - rheumatoid and osteo-arthritis. The few cases met with in this investigation where the diagnosis was uncertain, were not of sufficient number to merit the addition of a specific group, and these cases were left under the unclassified group at the end of Table III.

Let us examine now in more detail the osteo-arthritic group and note, where advisable, the difference between this and the rheumatoid type.

I have prepared a table in which the main clinical and aetiological differences are set out.

	OSTEO-ARTHRITIS	RHEUMATOID ARTHRITIS
Aetiology	? Lymphatic obstruction Degeneration	Infective
Average age of onset	40 and upwards	20-40
Sex Preponderance	Women : Men = 1 : 1	Women : Men = 1.5-2 : 1
Onset	Gradual	Abrupt or more gradual
Joints affected	Large joints - hip knee, lumbar spine	Many - mainly the small joints
Constitutional Symptoms	Slight or nil	Marked
Pain	Not usually marked	Usually prominent
Blood Sedimentation Rate	Low	High
Endocrine Disturbance	? Thyroid Dysfunction ? Pituitary Dysfunction. (Fletcher (32))	Doubtful
Bone	Osteophytes, increased density of bone	Osteoporosis
Ankylosis	Never occurs	Fibrous or bony may occur late
Lesion	Early degeneration of cartilage - ebornation of bone - proliferation of marginal and subchondral epiphyseal bone. Heberden's nodes formed. Little or no periarticular inflammation. No pannus.	Periarticular inflammation with epiphyseal infiltration. Late synovial proliferation pannus formation and cartilaginous destruction to be replaced by fibrous or bony ankylosis. Subcutaneous nodules late.

OSTEO-ARTHRITIS.

Osteo-arthritic changes have been noted historically in the skeletal remains of the Pleistocene Age by Elliot Smith, and of the Predynastic era in Nubia 3,500 B.C., by Wood Jones (85), while Stockman (98) has noted it in the skeletons of the Bronze age found in Scotland.

Clinical history is relatively short and this condition was first differentiated by Adams as the "Morbus Coxae Senilia". The main features have been more recently, and further, established by Stockman, Fisher (31), Buckley (8) and others.

It is difficult to assess the resultant incidence of this condition on account of the fact that the onset is usually extremely insidious and in many cases never gives rise to more than a mild, annoying and recurring ache. Glover (35), when investigating the incidence of chronic rheumatism in 58,000 male and 33,000 female insured workers, found 3 cases of osteo-arthritis per 1,000 male and 2 cases per 1,000 female. Keefer (49), however, at autopsy noted degenerative changes commencing in the fourth decade and found these changes in over 80% of the cases over 50 years of age, while Schmorl and Junghanns (81) in similar investigations found osteo-arthritis in 50% of the cases over 40 years of age with the percentage increasing with age. Buckley (6) noted higher incidence figures in those working out of doors or in hot surroundings.

The pathology is well established and clear, and has been fully described by O'Reilly (71). It is that of a slow degenerative process not proceeded by any inflammatory stage, affecting all the joint structures and occurring usually in a subject who is in the prime of life and not showing signs of any other disease. The first change is noted in the articular cartilage which separates into vertebral striae (fibrillation) and then becomes soft and practically eroded, more in the form of an ulceration, to the stage where the underlying bone becomes exposed. The bone on first exposure has a soft granular appearance but, due to friction of articulation, becomes ebornated and grooved at the articular end. At the periphery of the joint, where cartilage and synovial membrane meet, there is a compensatory hypertrophy of the remaining healthy cartilage, while the edge of synovial membrane produces new bone from its osteo-genetic elements. The hypertrophy of cartilage is irregular, becomes later ossified and continuous with the underlying bone, and gives rise to the marginal osteophytes which constitute the picture of joint "lipping".

This deposit takes place within the attachment of the joint capsule and gives an actual increase of joint surface and it is presumably in order to do this, and if possible assist the defective articular surface, that nature puts in operation this hypertrophic process; but the formation is irregular and nodular and serves merely to create greater difficulty in articulation by reason of increasing the content of the joint space. The ends of the de-

nuded bone show atrophic changes, rarefaction being present in the cancellous bone beneath the eburnation. There is deposit of granulation tissue in the spaces and the trabeculae are fewer. There may be found the epiarticular ecchondroses of Shattock - these being bone nodes covered with cartilage which develop on and project from the eburnated surface. Small irregular areas of cartilage may undergo ossification, which later form the foreign bodies so commonly found in the affected joint cavity. Ely (28) notes the presence of cysts at the end of the bone which have, in his view, arisen from a process of septic necrosis of bone leading to cystic degeneration. The synovial membrane, after an initial stage of increased vascularity, becomes thickened with villous processes. Another type of foreign body may arise from the splitting of cartilaginous nodules formed in these processes. In the later stage there is increase of fibrous tissue and the tissue is converted into a fibrous sheath. Differing from other forms of arthritis bony ankylosis never results, although some of the analogous symptomatic results may in the end be obtained through thickening and contraction of the capsule of the joint with osteophyte formation.

Leiche and Breukmann have produced experimental osteo-arthritis by various methods of direct damage to the articular cartilage - Wyatt (97) notes faulty posture and certain occupations as inciting factors. Van Breeman (93), who believes that every occupation has its own distinctive rheumatic deviation, gives as his experience that the joints most in use in a particular occupation show arthritic changes most frequently. Collins (19) stresses chronic trauma as an important factor. Poynton and Schlesinger share this view.

In connection with these pathological changes noted above, particular attention has been drawn by Fisher, O'Reilly (71), Rouvier (79), Mouchet, Noureddene (66), Kuhns (53) and others to changes in the lymphatic system. Fisher has shown that the synovial cavity is a serous space communicating with the lymphatic system. He points out that the synovial fluid, derived from the plasma, has the double function of lubricating the joint surfaces and nourishing the central and superficial portions of the articular cartilage, with the absorption of fluid waste products from the joint into the local lymphatic system. He has shown experimentally that damage to the central area of articular cartilage in healthy animals gives rise to changes in that joint typical with the changes of osteo-arthritis. It is also of interest to note here that Burckhardt (9) found osteo-arthritic changes in joints where the cartilage had been previously damaged with phenol, but also found that immobilisation of such joints at the time of damage prevented the arthritic changes from taking place. This indicates that movement in a joint whose cartilage has been damaged will eventually produce osteo-arthritic changes and is a point to be kept in mind when dealing with trauma as an aetiological factor. Handley (44) studied the effects of lymph stasis on tissues and noted in the skin such changes as proliferation of epithelial cells, hardness and leatherness of the affected tissue, great proliferation

and increased bulk of the connective tissue, papillary hypertrophy and a collection in the superficial dermis of lymphocytes unable to return via lymphatics and finally a nutritional failure producing superficial ulceration. It will be noted that these processes bear a close resemblance to the pathological changes described in the osteo-arthritic joint. Rouvier (79) showed that the synovial membrane is richly supplied by two net-works of lymphatics, one directly under the endothelium the other in the sub-synovial tissues, while lymphatic vessels traverse the capsule and ligaments to connect this sub-synovial net-work with an external plexus situated on the surface of the capsule. Mouchet and Noureddine (66) noted the intimate relationship of this inner net-work with the articular cartilage, and showed that the lymphatic vessels from the hip and knee joints go direct to the deep iliac glands, while those from the foot and ankle go to the popliteal glands, and those from the joints of the lumbar spine go direct to the iliac glands. In O'Reilly's view the distribution of osteo-arthritis is usually regular and limited to the hip, /knee, ankle and lower spine joints, and it becomes clear that the iliac glands form a distinctly possible focal point from which a disease process, spreading along the lymphatics, would involve the joints which are actually involved in osteo-arthritis. It was found by Kuhns (53) that suspensions of Indian Ink injected into the hip or knee joint passed directly to the external and common iliac glands, while injection into the ankle the ink passed first to the popliteal gland and later in a lesser degree from there to the iliac glands. It will be clear, therefore, that a pathological process affecting the iliac glands could have thus a direct anatomical and physiological base for producing a disease such as osteo-arthritis.

When examined radiographically the first stage in an osteo-arthritic joint is where the joint space is diminished on account of the cartilage destruction. This is followed later by lipping at the joint edges, due to the marginal osteophytes to which we have previously referred. Thomson (90) noted a cyst-like structure in the bone in close proximity to the joint and he relates the onset of acute clinical symptoms with the activity of these cysts, while Collins (18) notes a shift to the left in the polynuclear count, in cases where these large cyst-like areas are demonstrated. Thomson also notes in 68% of his cases the presence of small discrete calcified areas in the pelvis, which at post-mortem proved to be calcified areas in the lymphatic glands lying along the pelvic vessels. It is worthy of note that lipping by itself is not a definite sign of osteo-arthritis but may occur purely from constant trauma. There is often to be found dense sclerosis in the bone surrounding these cysts. Scott (82), who has investigated 300 cases of what are termed "spondylitis adolescens", notes that radiographically there is bony ankylosis of the sacro-iliac joints which may be calcification of the ligaments. He claims that it is possible to detect pathological changes in the sacro-iliac joint 6 or 7 years before there are any clinical signs of arthritis in the spine. He attaches great importance to this so called "pre-spondylitic syndrome" and goes so far as to state that these changes

in the sacro-iliac joints may be said to be pathogenic of this type of spondylitis. He stresses this point with a view to instituting preventive measures before the spine has become actively involved with the arthritis. This premonitory sign he terms a bilateral sacro-ileitis. Oppenheimer (70) states that it is now possible to observe involvement of the lower thoracic apophyseal and costo-transversal joints before sacro-iliac involvement.

O'Reilly (71) examined the iliac glands from cases at necropsy and found them to show chronic inflammatory changes with fibrosis and occasional calcification in the fibrotic areas. It will be noted that these are the calcified areas already referred to in the radiographic study. In the cases where the popliteal and epitrochlear glands were examined only fatty atrophic changes were found and he then sought a cause for the changes in the iliac glands. These glands are directly connected with, and receive lymph from, the inguinal glands and their vessels in the groin, and it is noteworthy that in cases where the symptoms were acute these glands and vessels were tender to pressure and traction. A search for a cause of inflammation in the inguinal glands showed a constant lesion in the feet. This was situated in the fourth interdigital space, the "erosio interdigitalis blastomycetica" of Fabry. In a typical case this space showed whitish patches of sodden skin, not infrequently fissured, with reddening, glazing and easy fissuring of the underlying skin. It was found that this was always accompanied by an infection of the toe nails shown by a yellow tinge in conjunction with loss of translucency and brittleness, progressing in neglected cases to onychogryphosis. In 20 cases in which a culture was made from the affected skin there was found:-

Monilia Pinoyi in pure culture	17 cases
" " and Monilia Albicans ..	1 case
Epidermophyton	1 case
Unidentified Monilia with pathogenic reactions	1 case

While this is not a big series of cases it represents a very high percentage of the cases with true monilia infection, and while the ringworm fungi has been long recognised as a cause of infection of the feet the pathogenicity of the monilia has only recently been generally recognised.

The entire subject of the monilia has been only in comparatively recent years thoroughly investigated. Castellani, in classifying the yeast-like fungi, noted four groups:-

1.	With no mycelium and no Asci ..	Cryptoccus.
2.	" " " but with Asci ..	Saccharomyces.
3.	" mycelium but no Asci ..	Monilia.
4.	" " and with Asci ..	Endomyces.

Langeron and Thalice (54), however, excluded from their classification the term monilia and substituted Mycotorula. Castellani claims to have isolated over 20 varieties of Monilia,

but MacLeod [58] and Muende [67] after extensive work have only distinguished with certainty two separate types - Monilia Pinoyi and Monilia Albicans. The main differences are indicated by Goldsmith [36] as follows:-

Monilia Pinoyi	Monilia Albicans
Budding oval Gram-positive spores, varying in size, with an average of 2.25μ x 4μ generally arranged in short chains. Mycelium scanty, short and usually non-septate and non-branching.	Budding oval Gram-positive spores, varying greatly in size, long diameter 1 - 6μ, usually arranged in clusters, Large number of branching mycelial elements with conidial spores in the region of the septa.

Cultures on Sabouraud's maltose-agar at 20°C.-

Monilia Pinoyi	Monilia Albicans
Small pin-head colonies make their appearance within 18-36 hours, and later coalesce to form larger irregular ones, smooth shiny and of a pale fawn colour. They are composed of oval budding cells with very few mycelial elements. With age the colonies lose some of their lustre and the microscopical examination then reveals the presence of more mycelium.	Thin "crinkled paper" brownish-yellow colonies appear within 18 - 48 hours. They are composed of masses of branching septate mycelium with clusters of oval spores at the septal nodes. With age the colonies become darker in colour and the surface matt; microscopical examination shows still greater tendency to mycelial development.

It has been shown the Monilia can vegetate harmlessly on the human skin and Jessner and Kleiner have isolated it from the nail groove of about 60% of normal persons. The pathogenicity of the monilia, however, has been proved by Radaelli, Jessner, Kleiner, Von Graffenried, Dowling [27] and others. It must not, therefore, be assumed that because this fungus can be found in normal people it cannot therefore be the cause on certain occasions of a pathological condition.

This form of infection is very prevalent and its prevalence increases with age. It was found in 38% of 200 patients suffering from a variety of conditions not including osteo-arthritis and while the figures are much higher than the clinical incidence of osteo-arthritis they agree more closely with the incidence of joint changes shown at necropsy, and what is very suggestive is that 11 of the patients examined in O'Reilly's group were over 50 years of age and were free from this infection. None of these 11 patients had any signs of osteo-arthritis. A point to be kept in mind is that the clinical incidence of osteo-arthritis is much smaller than the post-mortem incidence, as many cases of osteo-arthritis either do not progress far enough or do not have a sufficiency

of secondary factors to create osteo-arthritis of a symptomatic degree.

With regard to the general question of infection as related to osteo-arthritis. Cecil, Nicholls and Stainsby (13), Nye and Waxelbaum (69) and Gray and Gowen (41) are all in agreement that the bacteriological findings in osteo-arthritis are inconclusive. The only organism found in any frequency was the streptococcus viridans and this was also found in practically equal amounts in the control groups. The Haemolytic Streptococcus Agglutination test was negative in osteo-arthritic cases and although Crowe (23) holds that osteo-arthritis is due to a streptococcus this is neither borne out by pathological nor bacteriological evidence. This is further indicated by the finding of a rarely altered sedimentation rate in osteo-arthritis, a normal leukocyte count - apart from the previously mentioned cases showing the presence of cyst-like areas in the bone area where there was a shift to the left. Bannick et al (1) found the sedimentation rate normal in 100% of 25 cases, while O'Reilly found 83% normality in 53 cases. With regard to other biochemical findings Pemberton (72) and Cawdais (11) suggested a disturbance in the sulphur metabolism but Senturia (83) found no appreciable deviation from the normal glutathione concentration in the blood. With regard to such findings as increased cholesterol (Hartung (46)), 80% of cases with a non-functioning gall bladder (Haden (42)), 60% of cases with constipation (Haden), it must be kept in mind that these figures are not exceptional for the age group subject to osteo-arthritis.

Admittedly the cases investigated by O'Reilly were not large in number and consequently it is not possible to make unconditional use of his findings. Sufficient evidence has, however, been put forward to suggest very strongly that further investigation of this subject may well prove beyond all possible doubt that monilia infection is at least a big factor in the causation of osteo-arthritis.

Reference to the expected attack rate taken from Glover's figures show that the attack rate for osteo-arthritis in this group of men is considerably above the average.

Aetiologically we must consider especially that the occupation of these men takes place in the main out-doors and in surroundings which are an oscillation of hot and cold. The question of postural strain must be kept in mind and the important and large factor of vibration must be borne in mind. This leads to what has been termed multiple and repeated small traumata.

RHEUMATOID ARTHRITIS

The cases of rheumatoid arthritis met with in this investigation have not been outstanding in number and it is not, therefore,

proposed to deal at length with this condition. The comparative attack rate per 1,000 is distinctly lower than that met with in the Ministry of Health Inquiry of 1923 (35). It seems, however, advisable to outline some of the main work done showing the strong evidence in favour of an infective nature present in rheumatoid arthritis as opposed to the more truly degenerative nature in osteo-arthritis.

In a general symptomatic way there is usually found a more profound systemic disturbance in conjunction with a local inflammatory lesion and McEwen (57) has noted the high positive findings in these cases in the Hæmolytic Streptococcus Agglutination Tests. Dawson, Sia and Boots (26) noted a rise of the blood sedimentation rate and Davis (25) notes an alteration in the Plasma Proteins. Pemberton (72) concludes that the infecting organism is usually a streptococcus hæmolyticus or a streptococcus viridans but notes:-

"although probably any other organism is capable of producing the same results".

Cecil, Nicholls and Stainsby (12) investigated a series of cases of rheumatoid arthritis and found:-

In 154 cases of rheumatoid arthritis -
94 cases (62.3%) of streptococci in the blood.
In 49 cases of rheumatoid arthritis -
35 cases (67.3%) of streptococci in the affected joints.

They noted that the organism usually was of an attenuated haemolytic type, and this has been corroborated by Wetherby and Clawson (15). McCrae (13) included Arthritis Deformans, and stated that this was secondary to a focal infection. He expressed the opinion that the changes were often due to toxin rather than to infection in the actual joint. With regard to focal infection Cecil (14) stresses the possibility of tonsillar infection in young people and dental infection in adults.

Regarding the theory of bacterial allergy, Dawson (26) states that this as a possible cause of chronic arthritis "is little more than a hypothesis and a rather unsatisfactory one at that".

While there is as yet no definite proof that a Virus is the causal factor here, particles resembling virus bodies have been found by Eagles, Evans, Fisher and Keith, and these particles do seem to have some ætiological significance.

Fletcher (32) has recently suggested that the triad of obesity, hypertension and osteo-arthritis have a common ætiological factor, possibly endocrinal, and found obesity in 49.5% of 103 cases. O'Reilly found obesity in only 12% of his cases. The fact that

88 of Fletcher's cases were females might suggest one factor in his enhanced percentage.

SYNOVITIS.

In this investigation a separate group of synovitis has been classified. The majority of these cases have been of the acute traumatic variety where increased fluid has accumulated in the joint as a direct result of trauma. It is of interest to note that the highest percentage of these cases occurs in conductors, and that the highest percentage of all these cases was synovitis of one or other knee joint. This is in keeping with the view previously set out that the conductor, in the course of his work, is subject to more than average strain in his knee joints. In this respect it is of interest to note that damage to the semi-lunar cartilages has been noted most frequently in conductors.

PES PLANUS.

This group, of course, does not fall into the classification of chronic rheumatic conditions, and cases have only been classified as such where no other abnormality was found. In other words where a Fibrositis or Sciatica was being aggravated by a degree of foot drop the case has been left as a Fibrositis or Sciatica without any classification as Pes Planus.

GENERAL AETIOLOGY.

We have dealt in detail, where advisable, with the outstanding aetiological factors covering the sections into which the chronic rheumatic conditions have been divided. There are, however, further factors and aspects which apply more or less equally to all the allied conditions, and which can therefore be dealt with in a general way here.

We have noted the workers in hot and cold atmospheres as being especially prone to the fibrositic and neuritic type of conditions. Danieshevskij (24) collected records covering various occupations and found that the highest incidence of rheumatic cases was in workmen working in hot workshops. This was closely followed by engine drivers and stokers, and next by workers in cold workshops. It will be noted that engine drivers and stokers are working under conditions which vary from cold to hot. It should be clear from Section II of this work that the men employed in

omnibus work are in the main working under hot conditions with a greater or lesser element of cold from time to time. Glover instituted a similar and more complex investigation with regard to particular industries and found that the highest incidence was met with in workers with metals, machines and implements. This was next followed by general labourers and men employed in the conveyance of men, goods and messages. Bearing this in mind, and remembering that omnibus work has been shown as unduly heavy and exhausting work in the presence of alternating heat, cold and exposure, one can only anticipate a high rheumatic incidence in the group of men under consideration here.

It is worthy of note that the men employed on the inside staff, which in the average means a more sedentary work less exposed to the extremities mentioned above, show a considerably lower rheumatic incidence. This serves as further corroboration of the above contention.

A graph has been prepared - Table V - setting out the monthly figures of appointments made for treatment at the clinic. The appointments made for treatment are naturally a relatively true indication of the actual incidence. It was thought advisable to prepare this monthly graph in order to show whether or not there was any seasonal incidence of rheumatic conditions appertaining in this group of men. It was hoped to compare this incidence with the rheumatic incidence of other industrial groups. In the absence of available figures, however, this has not been possible and the only set of figures which present any reasonable means of comparison are those contained in the Public Health reports for Washington (92). It must be admitted at once that the general climatic conditions appertaining in London and Washington are not directly comparable, more especially as the summer conditions in Washington are relatively much warmer than in London. It is worthy of note, however, that the Washington incidence figures do not show any marked decline until July, whereas summer conditions have come into effect at least 4-6 weeks previously.

It will be noted from the graph that the four yearly figures show remarkably little variation when compared with each other. The only marked difference lies in the period March to May, 1937, and for this there were unusual and outstanding reasons, (see Section IV). It will be seen that whereas the Washington figures show a considerable incidence drop from July to October there is very little appreciable drop in the incidence figures prepared for omnibus workers. The obvious inference, even allowing for the obvious differences and difficulties in direct interpretation is that the seasonal effects are to a great extend counteracted and negated by the occupational effects which are present throughout the entire year. The rainfall figures covering this four year period were investigated in order to find whether there was any direct relationship between the incidence figures obtained and the weather conditions appertaining during that time. We have set out in Table XIII (page 81) the rainfall figures recorded at Camden

Square, N.W.1. during 1936-1939. It will be seen that it is difficult to correlate the rheumatic incidence figures against the rainfall figures as a directly causative factor, as where the high incidence months during 1938 may be attributed to the high rainfall during 1937 the converse does not apply that the low rainfall recorded in 1938 has brought about a lowered rheumatic incidence for 1939.

Rowlands (80) investigated the seasonal incidence of rheumatic fever in this country and found that while hot dry conditions predispose to the onset of rheumatic fever, it is the rate of change to damp cold which acts as the precipitating climate factor. He consequently took the view that one of the factors controlling the seasonal incidence of rheumatic fever in this country is the reciprocal acceleration of temperature and relative humidity. It is of interest to note in this respect that Newsholme (68) demonstrated that the incidence of rheumatic fever is highest in hot dry years, while Poynton and Schlesinger (75) stress damp cold as an outstanding factor.

The inability to trace any direct climatic factor in the omnibus workers leads again to the assumption that the occupational factors are in excess of, and probably counteract, the possible climatic factors.

TABLE XII

Branches of Work	Total Incidence of Rheumatism	
	Days	Cases
Whole Group	47.7	4.15
Workmen in H O T Workshops	101.5	8.62
Workmen in COLD Workshops	97.0	7.02
Engine Drivers and Stokers	117.7	8.17
Remounting Depnt. (Spares)	31.4	3.66
Accountants	26.3	1.76

Figures taken from "Le Rheumatism et le Travail Professionnel" by G. Danieshevskij

TABLE XIII

Rainfall (taken from hyetograph records)

1936 - 39

Month	1936		1937		1938		1939	
January		3.97		3.43		2.78		4.67
February		1.47		4.34		.48		.89
March		1.11		2.96		.34		1.32
April		1.36		2.64		.10		1.58
May		.48		2.89		1.43		1.53
June	12.21	3.82	17.75	1.49	5.47	.34	11.19	1.20
July		2.95		.53		1.17		1.62
August		.48		1.34		1.80		3.45
September		2.99		1.54		2.38		1.58
October		2.05		2.20		2.63		6.10
November		3.06		1.25		2.98		4.98
December	13.40	1.87	10.78	3.92	13.62	2.66		
	25.61		28.53		19.09			

NERVOUS MANIFESTATIONS.

This aspect divides itself into two large sections, firstly dealing with the general effects on the individual resulting from increased nervous tension, which are bound to impose a greater burden upon the carrying out of duties, and secondly the actual psychological manifestations which may arise.

Most writers in medical work at the present time deal in more detail than before with the general effects created by increased nervous tension and the increased strain which present day conditions impose upon the bodily reactions generally. Sufficient has been said, and the facts are sufficiently widely accepted, to make it unnecessary here to outline in any detail these general effects and reactions. Suffice it to note that with particular regard to the men under consideration here, increased volume of road traffic, a speeding up of running time of omnibuses and increase in the number of passengers carried - to mention but three outstanding factors - have resulted in the imposition upon these men of a much more exacting burden than previously (63). It is to be expected, therefore, that this will show itself in a greater liability to sickness than before. It is submitted that from the considerations in Section II of this work it should be clear that more than an average increase of tension has resulted in these men.

With regard to the more psychological aspect there are some interesting aspects to be considered. A reference to Table XIV (page 86) shows us that for the period March to May 1937 there was a period from the middle of March to the middle of April when the rheumatic incidence noted in these men was distinctly increased over the other monthly periods, and the weekly figures covering this period have been constructed in order to show this in more detail. It will be remembered that on 1st May, 1937 there took place a general strike of all the London Omnibus Workers, which terminated on 27th May. It is neither diplomatic nor relevant to discuss here the rights or wrongs of this united action, suffice it to note that the reason given for this action by the workers' representatives was that conditions imposed upon them at their work had become quite untenable. The fact remains, however, that during this period and for a period of weeks prior to the actual strike there was a time of gradually increasing mental stress involving these men, and there was indubitably a variance of opinion on both sides as to the ethics and even advisability of such action as was then taken. Conditions being so it is obvious that there was a more than usual amount of mental stress and strain all round.

In recent years much interesting work has been done and published regarding the possible psychological aspects in relation to rheumatism. Ellman and Mitchell ( ) reported on the psychological aspect of 40 rheumatoid and 40 osteo-arthritic patients while Halliday (43) in the Department of Health for Scotland particularly stressed the possibilities of rheumatic fibrositis having

a psychological background. He reported several cases where he notes a possible psycopathic background, such as a lumbar fibrositis which was directly traceable to a social error on the part of the patient whose subconscious mind was now, by means of the fibrositis, registering a c r y of remorse that this upright man had stooped so low. It is also possible that the physical fibrositis may be a manifestation traceable to a subconscious desire to have present a logical excuse for not carrying out some distasteful duty, by means of being absent on sick leave during the period. The work of Booth (3) also lends corroboration to these possibilities. It is obvious that there must be various aspects and interpretations which can fit into the various physical states, but the above proven examples serve to indicate some of the possibilities.

Fetterman (29) discussed the possibilities of post-traumatic neurosis of the spine and suggested that such often r e p r e sented "a protest of labour against capital", and advised that "physicians must look beyond the back to the background" in order to find any subconscious conflict with reality. The further step from this to what is termed by Ghormley (33) the "compensation neurotic" does not concern this present work, and with r e g a r d t o "rheumatic neurosis" generally it is very satisfactory to note the editors of the Annals of Internal Medicine (30) sounding a note of caution and giving the view that "most cases of backache are caused by real organic or functional disability". It has become too easy and acceptable to diagnose neurosis simply because no aetiological factor readily presents itself, and because of the mistaken view that the genuine workman is seldom found.

In the light of this possible nervous interpretation let us turn again to the weekly figures over the above indicated period of 1937. The man at that time was feeling a mental conflict regarding the possible future strike. Let us suppose for a moment that this particular man is not in agreement with any strike action being taken. It is surely not unreasonable to suggest that the subconscious mind of this man may be able to get out of this difficulty, and absolve this man from carrying out an action which is repellent to him, by the development of a fibrositis of the psychoneurotic type. This gives him legitimate cause for being off work at the time when the action abhorrent to him is taken, and he is able to rest content that he himself has not been responsible for the action and has had no part in it, in view of the fact that he was then absent sick. To take another aspect let us assume an omnibus worker who is in agreement with the proposed strike action and who, therefore, is carrying out his duties in the previous weeks in an atmosphere of, to him, righteous indignation at the unjust burdens which have been thrust upon him. It is surely not unreasonable again to suggest that his fibrositis was the outlet created by his subconscious mind searching for an honourable escape from this wrongly imposed burden. There is a third possible reason which may account for the increased weekly figures over this period, and it is not directly psychological. I am constantly examining patients at the clinic who, while being physically ill, are

anxious to continue at work while receiving treatment. In other words many of the men at work are already the subject of a greater or lesser physical disability, but from personal and service to the public considerations they are anxious to carry on at work. If, however, they felt in April, 1937 that they themselves were not getting a just treatment at the hands of the public it is again not unreasonable to suggest that they decided the time had come when their personal health could rightly be put before a service to people who did not seem willing to meet them halfway. Consequently they declared sick and applied for treatment.

It will be noted, and this is important, that the increased incidence figures noted at the clinic were over a period immediately prior to the strike. I make special note again of this fact, firstly because it gives greater weight to the psychological possibilities suggested above and in order to assist in combating a suggestion which was made by some people with regard to the omnibus workers' sick absence during this strike period. It was suggested by many people, whose minds seemed to have been biased, that many omnibus workers declared sick on the grounds that they would therefore draw more money on sick benefit than they would on strike pay. It seems reasonable to suggest that this would not apply to the pre-strike period when it must be remembered that the actual strike was then not a certain fact, and it is worthy of note from my own experience at that time that I did not sign sick absence certificates, during the strike period, in excess of the normal number which I signed from week to week. Should it be suggested by anyone that the lower incidence figures during the strike were because of transport difficulty in the men getting to the clinic, it should be remembered that each omnibus depot had its own private car arrangements for the transference of its sick men to and from hospitals and clinics.

Much interesting work has been done by Professor Collis (20) in his treatise on the "Coal Miner". Reference to Table XVI (page 88) shows us the figures quoted by Collis giving the relative strike ballots taken among the miners in different British coalfields. Table XV (page 87) gives comparative mortality figures among coal miners age 25-64. It will be noted that there is a striking similarity between these two tables with regard to the individual coalfields. In other words one finds, in the main, that the coalfield registering the highest mortality also registers the highest ballot in favour of strike. In other words, assuming, as does Collis, that "mortality may be held to be the final end of ill-being and to be some measure of its existence and so of the existence of the dissatisfaction it generates" and that a strike ballot is the direct indication of the extent to which dissatisfaction has prevailed, a greater dissatisfaction creates a greater mortality and presumably therefore the greater sickness not amounting to mortality. Sufficient evidence has, I hope, been given to show that nervous manifestations in all their wide aspects have got to be considered in connection with the rheumatic incidence amongst these men, and consequently there has also to be considered the possible

means by which the nervous tension may be lessened. Having shown in this unusual state of circumstances, covering a period of strike action, the possibilities of nervous and phsychological reactions we have no right to exclude this factor as being still present during more normal working conditions. In this respect it is of interest to note in Table XI that out of a series of 80 patients examined in greater detail at the clinic for some form of rheumatic or allied conditions, just over 20 stated that they preferred their previous employment. In other words they were working in their present occupations under conditions unfavourable to themselves, inasmuch as they were mentally dissatisfied with their occupations.

TABLE XIV

PATIENTS EXAMINED DURING 1936 - 37

Month	1936	1937	Weekly Figures: March-May, 1937	
January	53	38		12
February	65	52		8
March	59	47	March -	13
April	48	82		8
May	55	38		14
June	51	49		17
July	57	48	April -	22
August	43	38		21
September	37	29		14
October	49	42		9
November	45	46	May -	11
December	46	36		8
TOTAL:	608	545		10

TABLE XV

COMPARATIVE MORTALITY AMONG COAL MINERS - AGES 25-64 INCLUSIVE

COAL FIELD	1910-1912					1900-1902				
	All Causes	Phthisis	Pneumonia	Bronchitis	Accidents	All Causes	Phthisis	Pneumonia	Bronchitis	Accidents
Nottinghamshire *	570	53	40	25	66	675	64	52	49	80
Derbyshire *	591	70	34	39	73					
Northumberland & Durham	635	70	54	53	83	763	84	54	41	105
Staffordshire	717	74	70	61	109	846	66	71	104	118
Yorkshire	758	81	69	45	117	783	88	71	67	99
Monmouthshire & South Wales	777	70	69	66	131	951	93	108	104	169
Lancashire	941	107	100	88	185	1,006	96	149	113	131
All Coal Fields	727	76	64	51	118	885	89	86	79	123
Occupied and retired males	790	142	66	38	47	1,004	187	92	58	58

* Nottingham & Derbyshire were grouped together previous to 1910-1912.

TABLE XVI

RESULTS OF STRIKE BALLOTS OF THE MINERS TAKEN IN DIFFERENT BRITISH COAL FIELDS

* COAL FIELD	Percentage of Miners that voted		
	For strike August 1920.	Against resuming work June 1921.	Against wage agreement January 1924.
Nottinghamshire	55.1	53.7	69.2
Derbyshire	71.8	52.7	76.8
Northumberland & Durham	69.9	66.7	75.9
Yorkshire	51.1	65.3	75.1
South Wales	77.9	73.0	89.8
Lancashire	90.6	89.6	94.3

* Separate ballot figures were not published for Staffordshire, so that composite field is excluded.

SECTION V

CORRELATION OF SECTIONS II, III & IV

TABLE XVII [see page 92 for text.]

IMPORTANT AETIOLOGICAL FACTORS	FIBROSITIS	NEURITIS	ARTHRITIS	WHERE MAINLY OPERATING	PREVENTIVE MEASURES
Cold and Damp	F	N	?A	In Driving Cab. On Conductor's Platform.	Shorter journeys. Sprays, Drying rooms etc. at Depot Stations Improved Ventilation
Draught	F	N	-	In Driving Cab via Engine, open side of Cab and pedal openings in floor. On Conductor's Platform between stairs, open side and interior.	Close open side of Driving Cab. (Q) type). Inverted cups on pedals. Improved ventilation. ? doors on back of omnibus.
Immobility of Parts	F	-	-	In Driving - with back stiff.	More readily adjustable driving seat. Padding to maintain lumbar curve.
Fatigue	F	N	?A	General application.	Shorter journeys. Longer "stand time".
Posture and Strain	F	N	A	In Driving - constant flexed posture. In Conducting - stair work - effort to keep balance in omnibus.	Shorter journeys, more easily adjustable driving seat, maintenance of lumbar curve. Better adjustment of clutch pedal. Slowing down of speed.
Nervous Reactions	F	N	-	General Application - especial note of driving concentration.	Shorter journeys. Longer "stand time". Time for "unwinding" before meals. Slowing down of speed.

TABLE XVII

(continued)

Joint Inflammation	F	N	A	In Driving - via steering wheel and clutch. In Conducting - via direct trauma and maintenance of balance.	Decrease vibration effects - see below - More room at rear platform for Conductor to stand away from passengers.
Direct Pressure	F	N	-	In Driving - pressure of Driving Seat edge on mid - posterior thigh and Sciatic Nerve.	More adequate padding and adjustability of driving seat.
Trauma	F	N	A	From Steering Wheel and Clutch. In Conducting via passengers, seats and floor.	Decrease Vibration effects - see below - Conductors as in Joint Inflammation.
Vibration	F	N	A	On Driver from engine and road through steering wheel seat, and pedals. On conductor via floor from road.	Rubber or Tangential suspension of engine. Slower running time. Adjustment of tyre pressure to give minimum vibration effects from road surface.
Constipation	-	N	-	General Application.	Longer Stand Time. Shorter journeys. Increased canteen toilet facilities. Less frequent changes of shift.
Osteo-Arthritis	F	N	-	From Osteophytic Projections.	Apply to causes.
Fibrositis	-	N	-	From Constriction generally	Apply to causes.
Sepsis	F	N	R A	General Application.	- - -

SECTION V.

CORRELATION OF SECTIONS II, III & IV

We have already indicated in Section II the average stresses and strains to be met with in omnibus work. We have indicated in Section III the relative incidence of the various rheumatic manifestations found in the men employed in this work. We have set out in Section IV the general æticlogical factors which may be either primarily or secondarily responsible for these conditions. It remains now to correlate these sections together and indicate the æticlogical factors most prevalent in this type of work. A table has been constructed setting out the main applicable æticlogical factors against the particular part of omnibus work upon which they bear - Table XVII, including also a summary of the main preventive measures - and below we discuss these various points in detail.

COLD, DAMP and DRAUGHT.

These have been noted as strongly prevalent factors in the incidence of fibrositis and neuritis. It should be clear from Section II that the omnibus driver is in a vulnerable position with regard to these factors. He has to contend with an interplay of hot air from the engine, cold and possibly damp air from the open right-hand side of the driving cab, and also a cold draught coming up through the cabin floor round the sides of the pedals. With regard to the conductor his vulnerability in this respect, while being not so intense, is nevertheless high from the point of view of the platform at the rear of the omnibus. Here there is an inter-play of hot air from the inside of the omnibus with cold and possibly damp air from the outside and also a draught of air created between the top deck and the platform. This draught is especially marked when windows at the rear of the upper deck are allowed to be open.

IMMOBILITY of PARTS.

It has been shown that a fibrositis will readily arise as a result of immobility for a long time in one particular posture, page 56, and in this respect the driver is exceptionally prone inasmuch as he spends his entire driving time with the trunk more or less in a fixed posture.

POSTURE and STRAIN.

This follows directly from the previous paragraph and the maintenance for a long time of a posture which includes a certain amount of strain on the tissues is a strong causative factor in both fibrositis and neuritis, and to a lesser extent may affect arthritis. It has already been shown that even a mild strain will create havoc in the already vulnerable diathesis brought about by

immobility of parts, (page 56, Section IV). There must also be remembered in this respect the constant ascending and descending of omnibus stairs. The difference which this bears to the ordinary mounting of stairs lies in the fact that the omnibus is in motion and the vibratory effects are present with the result that there is a particular liability for the man to be thrown about on the stairs and to receive the multiple small trauma which have been noted as important aetiological factors in fibrositis, neuritis and arthritis.

JOINT INFLAMMATION.

The presence of joint inflammation is accepted as a factor in the production of neuritis and arthritis. If we consider an omnibus driver constantly holding a steering wheel, which has transmitted through it the vibration of the engine and of the omnibus generally, it will be readily admitted that there is here a potential source of joint inflammation in the upper limbs, and a similar position applies to the left leg from contact with the clutch. As regards the conductor he has to maintain an upright posture probably without the use of his hands, which are otherwise engaged in carrying out his duties, on a vibrating floor.

DIRECT PRESSURE.

This has been noted as a cause of sciatica, as particularly noted by Critchley (22), and the application is to the omnibus driver where direct pressure is brought to bear throughout the whole driving time on the sciatic nerve in the mid-posterior thigh.

CONSTIPATION.

This has been accepted as a possible cause of sciatica, and it must be kept in mind here, that while the toilet facilities maintained at the depot and other turning points are adequate in themselves, the fact remains that often enough sufficient time is not allowed for the proper utilisation of these facilities and also these facilities can only be utilised provided that the omnibus worker finds himself in the happy position of being at such a terminal point when the natural urges are felt. If the natural urge is felt at a time when the man is on his omnibus and has possibly another 30 to 50 minutes before reaching the terminal point, there is little he can do about it except wait; and no one will deny, in the light of previous experience, that failure to respond sufficiently promptly to a natural urge for evacuation of the bowels is one of the most potent causes of constipation.

VIBRATION.

Sufficient has been said in Section II to outline the possible relations of vibration. Suffice it now to indicate that apart from the general vibration from the road surface affecting the driver and conductor alike, there is also a vibratory effect on the

driver through the steering wheel and through the driving seat. These effects, which cannot be left out, are ætiological factors in fibrositis, neuritis and arthritis.

TRAUMA.

This follows clearly on vibration, as vibration in itself is a form of trauma.

NERVOUS REACTIONS.

We have outlined in Section IV, under the heading of Nervous Manifestations, many of the possibilities which may arise from increased nervous tension, and it is only apposite now to indicate that possible nervous reactions must be kept in mind as a factor covering the entire pathological possibilities set out in Section III. This question becomes of greater importance when dealing with the question of preventive measures designed to cut down the exciting factors from which these various nervous manifestations may arise.

FATIGUE.

This has been put forward as a cause of fibrositis and it is mainly so in a profession where long continuous use of a group of muscles does not allow of the oxygen debt to be readily made up, and allows consequently for the undue stasis of effete material into the tissues. This may become a chronic position whereby the natural processes may no longer be able, even in the presence of adequate time, to eradicate sufficiently the end-products of metabolism.

SEPSIS.

Much work has been done with regard to sepsis as an ætiological factor in rheumatic manifestations, and it is generally accepted that fibrositis, neuritis and rheumatoid arthritis may arise directly due to primary or secondary septic factors. It cannot be shown, however, that the men employed on this work are any more prone to sepsis, and therefore to its ill effects, than any other workers. Consequently it is not necessary to deal with this in detail here as it is, therefore, not a factor of particular application to this investigation.

SECTION VI

TREATMENT

SECTION VI.

TREATMENT

This section divides itself immediately into two separate parts:-

A - Symptomatic Treatment

B - Preventive Treatment

"A" - Symptomatic Treatment.

Treatment carried out at the clinic where the present cases have been seen and examined is almost entirely confined to physiotherapy and electrotherapy. We shall consequently deal mainly with such possibilities of treatment as are covered by these headings, and this is done from a dual point of view. It seems that the possibilities of physical and electrical treatments in dealing with rheumatic manifestations have not yet been sufficiently widely recognised. From this point of view it would seem right and proper to stress here the types and merits of such treatments. Secondly, as it shall be strongly recommended here that such clinics could with advantage be set up in the main industrial fields, it also seems right to point out the benefits to be derived thereby.

The types of treatment to be given in such a clinic might be tabulated as follows:-

ACTINOTHERAPY

Ultra Violet Rays
Radiant Heat
Infra Red Rays

LOCAL PACKS

Paraffin Wax
Mud - (Pistany)

ELECTROTHERAPY

Galvanic Current
Ionisation
Faradic Current
Sinusoidal Current
Diathermy
Short Wave Therapy

HYDRO-ELECTROTHERAPY

Schnée Baths.

HYDROTHERAPY

Immersion Baths
Whirlpool Baths
Foam Baths
Vichy Douches
Alternating Douches
(Scotch Douches)

RADIOTHERAPY

X-Ray Therapy

MASSAGE & MOVEMENTS

ADJUVANT TREATMENTS

Medicinal
Vitamin B.1
Plastic Foot Supports

Let us now deal with these individual treatments in more detail, dealing only with those aspects which seem to be more peculiarly applicable.

ULTRA VIOLET RAYS

The wave lengths employed here range from 1,000 to 3,900 Å units, and it is found that the short radiations are arrested by the skin where they produce photo-chemical changes. The longer radiations penetrate more deeply to produce effects on the tissues and blood circulation. Wave lengths of 4,000 Å units are required to reach the sub-dermal layers and consequently it is of benefit when using ultra violet light as a form of rheumatic treatment to have a source which is rich in visible rays. In effect there is created an erythrema of maximum intensity with rays of 2,800 to 3,100 Å units, degeneration of the skin, irradiation of the ergosterol present in the skin and a rising of the bactericidal power of the blood.

This form of treatment is found to be most effective as a general tonic measure in the debilitated patient, and when given locally may also serve as a useful addition prior to massage therapy.

RADIANT HEAT.

This type makes use of rays of wave length 4,000 to 7,000 Å units. The effects obtained are mainly those of heat alone, and it has been found that these rays penetrate more deeply than do the

Infra Red Radiations. In effect there is created a hyperæmia with increased lymphatic flow.

INFRA RED RADIATIONS.

This form of heat utilises waves of 6,000 to 14,000 Å units. It produces a visible hyperæmia by virtue of bringing more blood to the part and acts as a counter-irritant. Some noted that the shorter the wave length falling on the skin the greater the penetration. Bearing in mind that the higher the temperature of the source the shorter the wave length for maximum emission, it follows that when, in infra-red radiation therapy, penetration is desired, it is best to use a source with as high a temperature as possible. This follows from the two laws restricted to black bodies, and applying approximately to most sources, which have been set out by Taylor (89):-

(1) The quantity of energy liberated by unit surface of the black body is proportional to the 4th power of the absolute temperature,

or

$$\text{Energy} = \text{Const} \times T^4$$

(2) The wave-length which corresponds to maximum emission of a black body is inversely proportional to the absolute temperature,

or

$$\lambda_{(max)} = \text{Const}/T$$

We find the Infra Red Radiations mainly useful as a counter-irritant in fibrositis and neuritis, and as a good form of preliminary treatment to enhance the effects of the massage which is given immediately afterwards.

PARAFFIN WAX.

In this treatment wax of specially low melting point is used and it is found that this may be heated to 140 degrees F. for the application of such treatment. Usually the application is made in the form of a foot or hand bath and it has been found that when the foot is placed in such wax a thin layer of wax immediately solidifies on the skin at body temperature. This has the effect of enclosing between the wax and the skin a layer of sweat. The result is that an efficient insulating layer is produced between the outer wax and the skin. Temperatures can therefore be maintained in the melted wax without injury to the skin. There is enhanced circulation and a marked effect on the part treated. At the clinic it has been found that this is a convenient and satisfactory treatment for acute synovitis of the knee, ankle, wrist or elbow, and it has also proved useful in the treatment of gouty conditions of the feet. For application to the knee the wax may be applied in layers in the form of a pack. Phillips (74) recommends this form of treatment for arthritic hands and feet.

MUD PACKS.

This is another form of heat therapy with the advantage that certain effects are produced by reason of the inorganic and organic content of the mud - the type used at the clinic is mud from Pistany which is a sulphurous mud of volcanic origin. It is also stated that the radium content remains constant. There are no pathogenic organisms in the mud, while inoculated pathogenic organisms are rapidly destroyed. The mud may be applied in the form of a pack or as a bath, and, as in the case of wax, a temperature can be reached, without damage to the skin, in excess of that which could be obtained through the use of water. In effect there is an enhanced blood circulation through the part, with enhanced cytological and bactericidal effects, increased sweating and re-absorption of exudate. One advantage of this pack over the wax pack is that by the time sufficient depth of wax has been applied to the part much heat has been lost, whereas the mud pack can be applied directly it is prepared, without loss of heat. It has been found that the heating effect of the mud is more quickly obtained. This form of treatment has been found of especial service in the more gross forms of osteo-arthritis (86), and also as with wax in the treatment of synovitis and the gouty conditions generally.

ELECTROTHERAPY -

Galvanic Current - The direct current has two main uses:

1. The physiological use, by which means can be produced lowered excitability of nerves in the region of the pole and in the removal of exciting fluid in the tissues by cataphorises. It has been found that these effects are best obtained by immersing the part in a bath.

2. This current is very useful in the introduction of ions - ionization - it being found that, for example, Cl ions are effective in loosening scar tissues, salicylate ions have an analgesic effect, while Lithium ions could be used in the treatment of gouty arthritis. Kling and Sashin (51) recommended Histamine ionization.

The Galvanic Current serves, especially when surged, to stimulate muscle contraction and circulation, and has a place, therefore, in the treatment of Neuritis, Fibrositis, Arthritis and Scar Tissue Formation.

Faradic Current.

This is an alternating current, obtained from direct current by passage through an induction coil, and the secondary current so produced is found useful in the re-education and re-generation of wasted muscles. It is mainly given by means of a Bristow Coil

with either fixed tension or surged, or it may be given in the form of Schnée baths, where by the use of 4 cell baths the current can be sent through the body in any desired direction. A more elaborate apparatus is the Bergonié Apparatus, whereby current may be passed through various parts of the body.

WATTEVILLE CURRENT.

This is a modification of the above two types of current, which is produced by a faradic current reinforced by a galvanic current through the secondary coil. It is found useful for the stimulation of tissues of low excitability and, as with the others, is best when surged.

SINUSOIDAL CURRENT.

This is also an alternating current with the following advantages over faradism: the alternation is rhythmical and, in view of the rapidity of alternation, usually produces no polar effects. Consequently more current can be borne in this way than by faradism. Here again the best effects are produced by surging at a rate to suit the physiological rate of contraction of the muscles under treatment. It is beneficial in restoring the tone of muscles diminished in the course of joint affection.

DIATHERMY.

This is the production of heat in the tissues by the passage through them of a high-frequency oscillating current of high intensity. The electrical energy is transformed into heat in overcoming the resistance of the tissues, and as the current is oscillating with a frequency of about 1,000,000 per second there is no stimulation of muscles and nerves. As the current attains a considerable intensity it can heat the tissues many degrees, and can heat the body locally to a greater depth than can heat derived from other external sources. In the treatment the only sensation should be one of heat, and it is noteworthy that the joint is warmed from within outwards with consequent circulatory increase, promotion of tissue change, relief of pain, enhanced tissue/absorption and /exudate an inhibitory effect on pathogenic organisms. It is found of particular use in neuritis where there are present painful fibrous nodules and in arthritis which is exacerbated by trauma or constant use.

SHORT WAVE THERAPY.

This is divided into two forms:-

(a) "Short Wave Diathermy" where the oscillations are from 10,000 to 25,000,000 per second.
(b) "Ultra-Short Wave Diathermy" where the oscillations are from 25,000,000 to 120,000,000 per second.

In what might be termed long wave diathermy the current is passed through the patient's body through electrodes in close

contact with the skin, whereas short wave currents produce a condenser field in the midst of which the patient is situated.

In short wave diathermy the electrodes are insulated from the body, and the closer the electrode is to the skin, the more heating is applied to the skin and the less to the deeper tissues. This treatment may be given locally or as a general application and has a particular use in the treatment of Gonococcal Arthritis, Sinusitis and Carbuncles. This treatment has been reviewed and recommended by many, including Humphris and Pringle.

Ultra-Short Wave Diathermy is given by means of the electrodes of Schliephake and is of more importance in the treatment of acute inflammation and sepsis.

HYDROTHERAPY.

Immersion Baths.

These are used at the clinic and consist of hot baths impregnated with brine or Kiuma - which has in its content a so-called "Salicylate Ester Derivative". The effect is mostly mechanical and thermal. There is raised peripheral vascular tension with consequent increased cardiac action. By the support of the water, movement of limbs can be carried out more easily. The sweat and soft tissues are activated and, as there is no marked heat loss from the evaporation of sweat, the temperature of the body is raised. A good diaphoretic effect is produced. Our use of these baths has been for general muscular rheumatism where vague pains have had anaphoresis as a common factor. It should be noted that our use of such baths and also of any of the more heroic therapeutic measures is limited by reason of the fact that the majority of the patients undertaking treatment are still continuing at work. It follows, therefore, that any unduly harsh treatments must be left out of the general armamentarium.

Aeration and Foam Baths.

These baths have, in the main, similar effects to the immersion baths. There is a soothing influence experienced by the constant impact of air bubbles on the skin, while the presence of large quantities of foam would seem to have mainly a psychological effect.

Mud Baths.

The results obtained here are similar to those from the use of mud packs, and here again we refrain from using the complete bath in the presence of limited toleration.

Other Types.

Limited use is made of Whirlpool Baths, with soothing effects on wounds and scar tissues; Alternating Douches with general tonic effect when applied to the spine; Vichy Douche, of use in the relief of capillary statis and as a general stimulant.

Ray (78) makes the interesting recommendation that the affected hands be enclosed in rubber gloves and immersed daily in hot water for 20 minutes.

RADIOTHERAPY.

Considerable work has been done with regard to possible benefits to be derived from radio-therapy in the treatment of Arthritis. Hernaman-Johnson (47) takes the view that "the local application of X-Rays is of great benefit in cases of osteo-arthritis and may give local and temporary relief in rheumatoid conditions. It is valueless in true generative arthritis in the very old. The constitutional use of X-Rays is of pronounced value in checking the otherwise inevitable advance of spinal arthritis in young people, and its possibilities in the treatment of rheumatoid arthritis are worth investigating".

Scott shares the view with regard to spinal arthritis, but the general verdict with regard to rheumatoid arthritis seems to be that the benefit is slight, if any. Kemen (50), regretting that deep X-Ray therapy had not been much used in rheumatic diseases, stated that at Aix-la-Chapelle during 1936, 536 cases were treated in this way with very good results. He noted that the results were generally better in those cases where the septic foci had been previously eliminated. He recorded 109 cases improved out of 132 cases of Spondylitis Deformans and 82 and 73 improved in cases of Arthritis Deformans of the hip and knee respectively. It should be recorded that Cordon (38) considered deep X-Ray therapy contra-indicated in spondylitis, but Kahlmeter (48) thought it definitely useful.

MASSAGE AND MOVEMENTS.

This form of treatment is one of paramount importance in physical therapy, and many of the above forms of electrical therapy attain their greatest use and purpose as preliminary treatment to prepare the part for Massage, and thereby enhance the results to be obtained from Massage. The main effect and endeavour of Massage is to bring about a restoration of function by manipulation of the soft tissues. Several different grades and types are recognised:-

Stroking Movements.

(a) Superficial - with a sedative effect in cases of recent trauma and in neurasthenia. In this latter condition the special type of Massage as applied to the spine has been termed Feather Massage.

(b) Deep - otherwise known as effleurage. This form assists the flow of venous blood and lymphatics and has therefore to be carried out centripetally. It is also useful in stirring pathological changes of tissues where there is loss of elasticity in reduction of œdema before loss of tissue elasticity has rendered the condition chronic.

Striking Movements otherwise termed Tapotement.

This takes the form of anything from mild tapping of the part to forceable striking, even to the extent of striking the part with a hammer on wood.

Passive Movements.

By this we mean movement of a joint carried out with the muscles in complete relaxation. Such treatment is utilised to prevent the formation of any pathological structure and to conserve what joint movement is still present.

Active Movements.

In this the joint is actively moved by the patient to the limit of his ability and is then further assisted by the Accoucheur. The effect is to create gradual restoration of function.

Forced Movements - or Joint Manipulation.

In this form movement is carried out on the joint, with or without anaesthetic, with the intention to restore as completely as possible the full range of physiological movement without damage to the contiguous normal structures, and to break down any peri-articular fibrous adhesions. In this treatment particular care has to be taken to reproduce as far as possible the actual physiological movement of the joint. Mennell (59) makes this point clear and gives as examples movements of the hip and shoulder joint. Movement at the hip joint is practically without any sliding movement but the head of the humerus normally glides downwards and backwards in the glenoid cavity during forward flexion and abduction. He stresses that unless this gliding movement is restored, before attempted performance of the other movements, the upper end of the humerus will inevitably compress the soft structure between it and the acromion with relative damage to the soft tissues.

ADJUVANT TREATMENTS.

Medicinal.

The clinic at which the cases at present under review were seen is not equipped with a Dispensary, and consequently as a general rule medicinal treatment is not prescribed. In a limited number of cases, however, medicine is recommended and supplied by the patient's own doctor. It is noteworthy, in this respect, in how many cases electrical therapy alone is sufficient to render the

patient free of symptoms, and medicinal treatment where given is generally often designed to deal with other concomitant conditions.

Vitamin B_1.

This treatment forms perhaps the main exception of the above remarks regarding the absence of medicinal treatment. It has been long recognised that a certain number of neuritic cases were due primarily to a deficiency in Vitamin B_1. In 1937 a series of cases were treated at the clinic with this aspect in view (87). The conclusions then made were:-

"1. Vitamin B_1 therapy provides a factor often necessary for the efficient clearing up of a neuritis and without which the condition would probably remain chronic.
2. Vitamin B_1 therapy is useful in the treatment of general debility, loss of appetite, or impaired bowel action.
3. In the treatment of neuritis it is best combined with some form of physiotherapy.
4. It should be given in daily intramuscular injections of 1 mgm. for a course of two to three weeks."

Plastic Foot Supports.

In the statistical data we have dealt briefly with the subject of Pes Planus. Many methods of treatment have been from time to time prescribed to aid this condition. At the clinic we have found that Galvanic Baths combined with foot exercises are very helpful in re-educating the muscles and ligaments of the foot to re-assume their normal function. Cases have arisen, however, where either the condition has become too advanced to respond to such treatment or the response has been unsatisfactory. Such cases have derived considerable benefit from the use of the Lettermann Plastic Foot Support, and indeed in the majority of such cases it has been found that use of such a support for six to twelve months has usually been sufficient to bring about a permanent improvement in the condition, to the stage where the wearing of supports is no longer necessary. This form of support seems to me to attain the most active efficiency with the least possibilities of endangering the already poor tone of the muscles involved. Here a rubber-like vegetable composition has been produced which possesses the property of being thoroughly plastic above body temperatures, of preserving its plasticity for a time and of passing then into an unalterable state without, however, losing its elasticity or its assumed shape. It is therefore possible to suit the support exactly to the shape of each patient's foot, and, on the other hand, the continuing elasticity guarantees light and comfortable walking.

In a bag of the form of a sole this composition is brought to plasticity by heat and placed in the shoe, in which the patient should at once walk. The known carrying surfaces of the foot - heel, outer edge, forepart of the foot - press on the plastic mass

with the whole weight of the patient's body. The mass finding no way of escape can then, according to physical laws, only go to the place of least resistance, namely, into the hollow of the foot. By means of the immediate walking, the functioning muscles, ligaments and tendons have their movements held free and grooves for their tracks are formed in the support. There is now every encouragement for the muscles and ligaments to resume their full natural functions, whereas with the more standard type of foot support, and especially those with a metal basis, there is little or no allowance made for individual differences in shape of foot or shoe, nor is there room left for the muscles and tendons to function properly.

Most orthopaedists are agreed that the most essential form of movement to be encouraged in disabling conditions of the feet is the active individual muscular one, and, failing that, the passive movement. Any appliance handicapping such active movement, or its return, must obviously tend towards a progressive deterioration of what movement there is left. The great advantage of a support which allows of this essential freedom, while at the same time filling accurately each individual foot, is exemplified by the beneficial results which have been obtained by using this type of support.

Let it be understood that I am not in any way suggesting this as a substitute for massage and remedial exercises, which are most effective in some cases and should certainly be given first place in any scheme for the treatment of pes planus, but rather as probably the most advanced form of foot support both in theory and in practice.

"D" Preventive Treatment.

In Table XVII there have been set out in brief the main preventive measures which might with advantage be used as a means of cutting down the incidence of rheumatic manifestations. It is advisable now to deal with these measures in more detail.

The Driving Cab.

We have already alluded to draughts as affecting the driver and we have to deal mainly with two sources of origin, the open right-hand side of the driving cab and the slots in the floor through which the pedals protrude. There seems no reasonable reason why the right-hand side of the cab cannot be fitted with a door, with a small aperture through which the driver may exhibit the normal road signals. This aperture could be closed by a sliding mica flap. The one possible drawback to fitting a door here is, I believe, that in cases of accident it is sometimes found that such a door becomes jammed and it is not possible to extricate the driver without cutting away the door. As accidents are less common than the incidence of fibrositis and neuritis it seems that this drawback is of less importance than the enhanced rheumatic incidence involved. The present "Q" type of omnibus conforms relatively to this suggestion. With regard to the pedals it would seem both practicable and beneficial to have some form of inverted cone - preferably of rubber - which would serve to check the main draught coming through this aperture. It follows, naturally, that with the cessation of these draughts the ventilation system will need to be readjusted, with especial reference to the prevention of engine fumes entering the cab.

The driving seat leaves a certain amount to be desired. While most of those issued are now adjustable to a certain degree there is still not sufficient adjustment for the very short or very tall type of man, and the consequence is that undue strain and pressure is created. The recommendation here is, therefore, increased adjustment facilities. The seat itself could be improved by better springing, and this would tend to lessen the difficulties arising from strain and pressure on the sciatic nerve in its course down the thigh. The back of the seat at present is relatively straight and has no facilities for the adequate protection of the natural lumbar curve. The installation of a small adjustable cushion would seem a simple way of remedying this fault. One other change which could advantageously be made affects the clutch pedal. In many of the omnibuses, especially the type known as the S.T.L., the upward face of the clutch pedal is fixed at a too vertical angle. The result is that the left foot of the driver "rests" between gear changes in a position of acute dorsi-flexion with consequent strain on the muscles in the calf and undue flexion of the anterior muscles of the leg. A pedal set in a more horizontal position would alleviate this difficulty.

Conductor's Platform.

Here again the outstanding factor is draught and the main sources of emanation are from the outside, from the stairs of the omnibus and from the inside of the omnibus. I hesitate to recommend the complete adoption of doors at the rear of the omnibus, as this would entail undoubted inconvenience with regard to entrance and exit of passengers, but on such omnibuses where doors have been fitted the lesser amount of draught has been appreciable. The draught which is created from the stairs is usually due to windows at the back of the omnibus being open on the upper deck. It would be a simple and effective measure to render such windows permanently closed and thereby cut out this source of draught with beneficial results.

Vibration.

We have already dealt in detail with vibratory results and have made reference to vibration both from the engine and from the road surface. As regards the engine the most up to date form of rubber suspension, whereby the engine is entirely suspended in a rubber bed offers the best way of minimising the vibration. This type of suspension has been found expensive inasmuch as rubber deteriorates easily and requires renewing from time to time, especially in view of the oil and other products which come into contact with it. It should not be necessary, however, to state that a matter of health comes before a matter of expense when dealing with a public service such as this. If, however, the expense involved is found to be too high then the adoption of tangential suspension of the engine should become compulsory as being the next best way of eliminating the gross forms of engine vibration. With regard to vibration from the road surface, there are two ways of minimising this effect. Lessened pressure in the tyres - adjusted so as to produce the minimum of vibration rather than so as to give the maximum of mileage. Secondly running the omnibuses at decreased speed will also serve to minimise the vibration transmitted.

General.

We have indicated previously the various deleterious effects from increased nervous tension, due to excessive strain from maintaining higher speeds than before in the presence of increased traffic difficulties and particularly the length of time allowed for what has been termed in the Ministry of Labour Report "unwinding" (63). The application of a shuttle system of the omnibuses in the Central London Area would go a long way towards mitigating these effects. By these means the men would have more frequent reliefs from duty and would not, therefore, be subject to the stresses and strains of working for such long periods. This system has already been advocated in the Bressey (5) report into traffic conditions. Were this system adopted - and even in its absence - opportunity should be taken to set up more substations with full canteen and toilet facilities. These stations should have adequate

canteen facilities to supply nourishing and easily assimilated foods, and not merely the meat pie and much over-infused tea which is so characteristic of many canteen arrangements. There should also be facilities whereby the men at the conclusion of duties may have hot and cold showers both from the point of view of preventing those troubles which may arise from the collection of sweat on the body and from the point of view of re-vitalising the tissue efficiency. At the same time facilities should be provided for drying the clothes which have been heavily soaked with sweat, in order that the men may return home in warm dry clothing and consequently free from danger, rather than that they should return home in cold, damp clothing with the risks entailed from such a state of conditions. The increased substations would also have the effect of creating better and more adequate toilet facilities, which would go a long way towards eradication of the factor of constipation.

One other point which might, with advantage, be adopted is a less frequent change of shift. As already indicated shifts are changed usually week by week with a result that the normal functions of the body are constantly in a state of disordered activity inasmuch as sleeping, eating and working are never two weeks carried out at the same times. While admitting that a less frequent change of shift might bring with it some disadvantages, there seems every likelihood that the advantages to be gained would be greatly in excess of the disadvantages incurred.

TREATMENT CENTRES

It would seem that at the present time when more notice is being taken with regard to the preventive side of medicine that the need for the setting up of treatment centres would be widely recognised, and I think sufficient has been indicated in this work to make it clear that much can be done in such a treatment centre. Poynton and Schlesinger express the view that preventive treatment against chronic ill-health should be one of the first considerations, and Osgood also takes this view in his essay on "The Human and Economic Problems of Chronic Arthritis". Poynton and Schlesinger (76) outline in some detail the most effective measures which should be adopted as follows:-

(A)

"1. Modern hygienic factories with good ventilation and light. The introduction of more extensive mechanisation and the provision of increased protection against excessive high and low temperatures together with the exclusion of draughts.

2. Shortening of working hours with frequent rest periods in unhealthy occupations.

3. More careful choice of profession, and avoidance of occupations liable to produce rheumatism, for those who are inclined to be rheumatic subjects.

4. General improvement in mode of living, food, clothing and lodging. This could include:

(a) Corrective gymnastics.
(b) Provision of proper rest and healthy leisure; showers and rest rooms in factories.
(c) Periodic medical examinations.
(d) Transfer to healthier occupations, when necessary in certain cases.
(e) Health campaign by propaganda.

(B)

In connection with every industrial centre, adequate means for physiotherapy and balneotherapy should be provided. This should be in the hands of a team of doctors, who should make a scientific study of the results.

Special measures for miners have been suggested by Kohan (11):-

1. Cooling-off rooms.
2. Change of damp clothes.
3. Refreshing douches.
4. Rest before returning home.
5. Six-hour shifts underground.
6. Improvement of housing conditions."

They note that in those countries where such measures have already been adopted good results have been recorded, while in this country the provision of pithead baths has been an undoubted factor in the improvement of the health of the mine workers.

Copeman (2) reporting on the "Control of Industrial Rheumatism" expressed the view that "the basis of an active campaign would be early diagnosis, and the establishment of physical treatment clinics in towns". He also outlined a scheme for the prevention, detection and treatment of these rheumatic cases and here again I have no hesitation in quoting the scheme in toto.

"1. Exposure to extremes of heat, cold and moisture. Draughty offices, etc. Provide drying rooms, etc.

2. Hygiene - Dietetic, e.g., "Tea and bun habit"; beer; lead; general hygiene.

3. Occupational fatigue. Mechanical trauma, such as trauma from undue or unilateral loads; for example, it is suggested that dock labourers be limited by international agreement to loads of 150 lb., to save hips and backs. Undue or unilateral strains due to design or position of machinery, postural defects, provision of pit-head baths at mines, etc.

4. Mental strain, especially in women. Rest pauses where band conveyor is used. Variation of occupation. Recreation and sport.

5. Housing - See Architects' B.M.A. Report re juvenile rheumatism; damp-courses, situation of sites (M.O.H. has considerable power), sunlight, etc.

6. Infection. Focal, and untreated traumatic sepsis. (Sunlight and breathing exercises for sedentary workers)."

It will be noted how strongly similar are these two preventive schemes, which bear further watching with regard to the desirability of their adoption. Glover (35) also expressed the view "no scheme of treatment for chronic arthritis can be considered complete unless it provides for a large range of physical methods..... and this can only be secured economically if the treatment, as far as out-patients are concerned, be given in physical treatment centres equipped to deal with a large number of patients..... These centres should be arranged in close liaison with the authorised units and with the Spa Hospitals which should provide a continuous supervision, observation and necessary after-care, including education in simple remedial movements. Such centres would be of the greatest service". It would seem unnecessary for me to do more than to state that the experience at this clinic has shown that these views expressed by experts with regard to treatment centres are not only entirely correct but ones which ought to receive as soon as possible both universal recognition and universal adoption. The fact that the British Empire ~~Medical~~ Rheumatism Council also share these views leads to the hope that at an early date something concrete will be done towards the setting up of such clinics throughout industry generally.

SECTION VII

SUMMARY AND CONCLUSIONS

SECTION VII.

SUMMARY AND CONCLUSIONS

Opportunity has been taken to examine the incidence, aetiology and treatment of rheumatic and allied manifestations occurring among a representative group of the Central London Omnibus Workers. An attempt has been made to find out as far as possible the most ~~cogniable~~ outstanding / causative factors of these conditions, in order to outline ways in which some of the invalidity caused might be lessened.

The group of men taken has been that of the London General Omnibus Company's Friendly Society, and these men have all been examined at the Society's Rheumatic Clinic.

While it cannot be claimed that all rheumatic illness occurring in these men has been included, there has been obtained, nevertheless, a comparative figure with regard to the various types of conditions found.

The classification of chronic rheumatic conditions made by Glover has been adopted as being the one in most common use. A summary has been made of all the conditions, rheumatic and non-rheumatic, for which treatment is provided at the clinic.

In Section II the average working day of the Central London Omnibus Worker has been outlined with especial reference to hours of work, rest periods, meal facilities, type of omnibus in service, weather conditions, road conditions and the conditions appertaining to public service. The main outstanding points creating excessive stress and strain in this work have been summarised as follows:-

1. Affecting mainly the omnibus driver:

   (a) Fumes from the engine.
   (b) Draught entering the driving cab from the open offside.
   (c) Draught entering the driving cab from the sides of the foot pedals.
   (d) Postural strain due to lack of provision for lumbar curve, and due to insufficient spring to relieve pressure on the sciatic nerves.
   (e) Gross lumbar sweating due to the heat of the engine.
   (f) Constant mental effort required for negotiating traffic and other road conditions while endeavouring to run to schedule.

2. Affecting mainly the omnibus conductor:

(a) Draughts encountered while occupying platform at rear of omnibus.
(b) Trauma to legs and arms from passengers' luggage and due to efforts to maintain a stable equilibrium in the presence of omnibus vibration.
(c) Mental effort required to meet the demands of the general public, to pacify and to ensure that the passengers do not contravene traffic regulations.

3. Affecting both drivers and conductors equally:

(a) Constant weekly change of duty times involving irregularity of meal times, spreadover duties involving long periods while the intervals between duties are not of sufficient length to allow of real relaxation.
(b) Vibration from the engine and from the road.
(c) Relatively very short time allowed on turning the omnibus at the terminus, with consequent shortage of time for refreshment, relaxation and general toilet.
(d) Insufficient opportunity for rest of mind and body prior to partaking of a meal.

In Section III has been presented the main statistical data. This consists of Tables:

(3) Individual incidence figures 1936-1939.

(4) Monthly figures of appointments, absentees, attendances and treatments 1936-1939.

(5) A graph representing all the important points of Table IV and the clinic figures for 1931-1939.

(6) Estimated compared with actual figures 1936-1939.

(7) Discharge figures showing the results of treatment 1936-1939.

(8) Comparative figures for Central London Omnibus Workers against the Ministry of Health figures.

(9) Rheumatic Disease Incidence - Ministry of Health Inquiry.

(10) Occupation and Rheumatism - Males - Ministry of Health Inquiry.

(11) Details of 80 cases examined in greater detail.

In Section IV have been set out the main aetiology and pathology of the individual conditions in the chronic rheumatic classification.

In Section V the main aetiological factors set out in Section IV are correlated with the situations affecting the omnibus workers, and in which they have most deleterious effect.

In Section VI has been set out the main forms of symptomatic treatment which have been used in combating the rheumatic conditions affecting the Central London Omnibus Workers. Emphasis has been given to the possibilities of physiotherapy and electrotherapy. Secondly there have been outlined the main preventive measures which might, with advantage, be adopted in order to bring about a lessened invalidity. In conclusion of this section have been noted authoritative views with regard to the benefits to be derived from the setting up of treatment centres for the proper accommodation and treatment of such industrial workers.

In general it has been shown what industrial factors and hazards might be expected most heavily to affect the Central London Omnibus Workers as causes of the various rheumatic manifestations, and a scheme has been outlined whereby many of these factors might be reduced in effect by the adoption of adequate preventive measures, and also the steps have been indicated whereby the established condition might be adequately treated.

It has been shown that the abnormal stresses and strains of omnibus work have created an abnormally high incidence of Fibrositis, Neuritis and Osteo-Arthritis.

An attempt has been made to show what factors are most likely to have brought about this high incidence, and several ways have been outlined by which these factors may be eradicated in whole or in part.

A full bibliography has been appended of the authorities cited throughout the text, with the works from which their views have been extracted.

SECTION VIII

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SECTION VIII.

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